EDITORIAL

NUMBER of passengers carried by the various San Francisco Bay ferries increased from 42,872,822 for the year ended June 30, 1914, to 43,763,678 for the year ended June 30, 1915.

JITNEY buses are on the wane throughout the State of Washington. The last legislature passed an act requiring all buses operating in cities of the first class, namely Seattle, Spokane, Tacoma, Everett, and Bellingham, to file a bond for $2500. After the passage of the act, 911 of such bonds were filed, but since that time 83 of these were canceled, and no new ones have been taken out.

LINCOLN Highway will soon appear in the 'movies,' so may fairly be said to have had its status definitely established. A party of officials of the Lincoln Highway Association and others have traveled by automobile from the Atlantic to the Pacific Ocean, taking several thousand feet of film on the way. They report 75% of the roads along the way as being in good condition, 15% in fair, and 10% in poor condition. The poor roads are mainly in the desert regions.

PROPORTION of automobiles to inhabitants appears, in a given district, to vary directly with the condition of the roads. Figures compiled by the California Motor Vehicle Department show that Orange county, where the roads have been both well and economically constructed, has one automobile for every six voters. Los Angeles and San Joaquin counties, also noted for good roads, has each one automobile to eight voters. The proportion in some other valley counties is as low as one automobile to 14 voters, and in some of the mountain counties there is only one automobile to 29 voters.

IN an editorial in our July issue, commenting upon what seemed to us an unfortunate decision by the voters of Kings county, California, with regard to the type of construction of their proposed highway system, we made the statement that an engineer had not been employed by the county highway commission. This statement, which was made on what we supposed was good authority, we are informed was incorrect, the Commission having had the advice of Mr. Benn Duffield, county surveyor for Kings county, in planning the highway system. Our one interest in this matter was to emphasize the importance of employing engineering advice during all stages of an engineering project, and we wish therefore to make this acknowledgment to Mr. Duffield and the members of the Kings County highway commission.

OIL-STOCK dividends, like those in most ordinary enterprises, may be simply interest that will continue to be paid for an indefinite time. Where a company maintains an amortization fund, from which it makes fresh investments, this is usually the case. When, however, whatever apparent profit remaining at the close of a year's transactions is divided among the stockholders, a large part, if not all, of the dividend is really a distribution of a rapidly wasting asset. The Federal income-tax law has given this question a new aspect. Thus a man who has received a 10 per cent dividend for 10 years from a company that goes out of business at the end of that period might be taxed a considerable amount, but would in reality have received no income at all, simply a return of the capital invested without interest. Such an arrangement places an unusual burden upon oil-production and similar industries.

'COMMERCIALISM' is a word that sticks in the crop of many engineers. Nevertheless, all of them would be better engineers if they gave more consideration to the economic phases of engineering. In the final analysis it is the dollar that counts, and the man who can devise ways and means for making the dollar have a greater purchasing power in terms of public service is a benefactor to the race. If in the process of so doing, he earns a small fraction of the dollar for himself or his employers, this is merely incidental. It was commercialism that produced gasoline for 11½ cents per gallon, the Mazda lamp, the automobile, and in fact every single thing that provides the creature comforts, luxuries, and necessities of modern life, and the ideas and inventions of the engineer are of comparatively little consequence without the directing brain that places them into execution and within the reach of the consuming public.

OUTWITTING a contractor seems to be a favorite sport of certain city and county officials, the idea seeming to be that the contractor is a rascal anyway, and entitled to no more consideration than any other outlaw. The board of supervisors of Tulare county, California, recently awarded a contract for a bridge at a price that was about 80% of the engineer's estimate. The report of the meeting at which the award was made, naively states that while the Board felt certain that the contractor had made a mistake in his bid, particularly because he had received the plans only the day before, they lost no time in accepting the offer. It is possible that for some reason unknown to the supervisors, the contractor felt that he could build the bridge at a profit, notwithstanding the low price. Even if such had been the case, no harm could have resulted from taking the bids

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under advisement and communicating with the contractor. If what the supervisors suspected is true, either an inferior job will be done, or the contractor will lose money, with the probable result of bankruptcy, re-letting of the contract, and other attendant evils. That the contractor who tries the first course is dishonest, remains undisputed, but that the persons are far from blameless who force him to choose between that and bankruptcy, is not so generally appreciated. Nor is the fact generally understood that only harm can come from forcing a contractor to perform work at less than a fair price. It has been suggested that fair treatment of the contractor in this respect may lead to irresponsible bidding, but the irresponsible bidder is easily recognized and can be eliminated in other ways than by the extortion of a 'pound of flesh.'

ORIGINAL cost of local improvements, whether street-paving or sewers, is usually met by the owners of the abutting property. Where it is believed that the improvement is of benefit to other property, a local district is sometimes formed, and the cost of the work distributed according to the real or supposed benefit to be derived. To estimate correctly, in a given case, what these benefits are, requires a composite of Solomon and the Angel Gabriel in proportions seldom seen on this earth. Another frequent cause for dissatisfaction is the fact that a property owner may sometimes be called upon to pay the whole cost of paving his own side-street, and then, a few years later, have to pay part of the cost of improving the main thoroughfare that runs past his neighbor's house. In the case of street paving, at least, the actual benefit received is distributed, in a greater or less degree, over the entire community. A division of the cost of local public work between the abutting property-owners and the entire municipality would prevent irresponsible demands for unnecessary improvements on the one hand and onerous taxation of adjacent property on the other.

CHANGED traffic-conditions are, it is well known, responsible for much of the deterioration so frequently observed in roads and pavements that were considered permanent when first constructed. Automobile traction has increased both the size of the loads and the speed with which they are carried. Perhaps the commonest way of meeting these new conditions is to do a great deal of talking and a very little of patching of the existing street-surface. Another way is to go to work to improve the pavement so that it will carry the traffic. This is expensive, and it may be that in some cases it is too expensive, at least for the time being. A third way is to limit the amount of load and the speed of vehicles using the pavement. The city of Berkeley, California, while preparing plans for street-paving, is at the same time considering the passage of a traffic ordinance with sweeping provisions in this regard. Heavy trucking, whether by automobile or otherwise, is prohibited in most of the residence districts and considerably restricted elsewhere. Five miles per hour is the limiting speed for vehicles weighing more than three tons, or for all vehicles without resilient tires, and twelve miles is the limit for other vehicles. While some limit to speed has always been recognized as essential for safety, and it may be that some limitation as to weight is desirable, it is easy to go too far with such regulations. Transportation by automobile truck is an important factor in reducing the high cost of living and its success depends upon a reasonable amount of liberty with regard to both speed and weight. It is to be hoped that the city council of Berkeley will amend the proposed ordinance considerably before its final passage.

Soft Roads and Hard Usage

Motorists whose privilege it has been to travel over the upper Stockton road from the city limits of Sacramento to Galt have had a real opportunity to study the effect of a certain type of road construction with respect to its ability to withstand motor-vehicle traffic. Beauty is said to be only skin deep, and so it is proved to have been with this particular piece of road. Upon skinning, which process has been faithfully carried out by thousands of automobiles, the veneer of beauty has indeed proved to have been painfully thin. It is another instance of the old story, that a road is as good as its foundation, while the parable about the man who built his house upon the sand seems to have been forgotten by the makers of the road in question. Now, as is customary, somebody has to pay. The State Highway Commission of California is about to take over this road from the county, and, as a preliminary investigation, has had a survey made of the condition of this road at present and an estimate of the probable cost of putting it in similar condition to the state highway proper. As a result, it has been determined that for the section between Sacramento and O'Connell, 16 miles, the expenditure required will be $1000 per mile. Between O'Connell and Galt no estimate has been made as much of the repair work will have to be done on trestles, while in five different places the road foundation will have to be entirely re-built. This road has been in use for about five or six years and cost originally from $8000 to $10,000 per mile. Oil macadam was used, and under the severity of the traffic it has deteriorated rapidly. Excessive oiling has contributed largely to the present condition and has probably hastened the raveling of the foundation when the surfacing showed signs of wear. In any event, it seems to be another demonstration of the wisdom of the selection of portland-cement concrete by the California Highway Commission as a foundation for the greater part of the state highway. This kind of foundation with an asphaltic wearing coat, cheaply repaired and renewed, seems to come as near to an ideal road as the present state of the art makes it possible to build. In the meantime, counties contemplating road improvements will do well to remember that five-year roads built with the proceeds from the sale of twenty-year bonds do not pay.

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REVIEW OF THE MONTH

SEPTEMBER is the month for engineering conventions in San Francisco. The programs of two of the more important gatherings, the International Engineering Congress and the Pan-American Road Congress, are printed elsewhere in this issue. While both the attendance and the co-operation of foreign engineers in the former Congress has been seriously interfered with by the War, it will be readily seen from the papers that are to be presented that it will be one of the greatest gatherings of engineers ever known.

PAN-AMERICAN Road Congress, which started as the joint convention of the American Highway Association and the American Road Builders' Association, has broadened its scope to include the Tri-State Good Roads Association, composed of road-men in California, Oregon, and Washington, and the Pacific Highway Association, which has a similar membership, but is especially concerned with the construction of an improved highway along the Pacific coast from Alaska to the Mexican line. All those bodies interested in road-construction and road-improvement, will therefore meet at one time, although preserving their separate organizations.

WAR-MAPS of the kind published in the extra editions of the evening papers are familiar to us all, but comparatively few, even among engineers, have considered the important part played by the map-maker in the present War. The work of the Royal Geographical Society of London, in the preparation of a map of Europe on a suitable scale, has recently been described by its secretary, Mr. Arthur R. Hinks. Several sheets of the well-known international map of the world had been prepared, but some of these were outside the scene of operations, and one was an enemy sheet and therefore unobtainable. Under these circumstances, the society decided to compile as quickly as possible the best substitute for the international map as it was originally projected. As may be readily imagined, one of the chief difficulties experienced has been an approximation to a uniform standard of spelling.

OIL-OPERATIONS in the vicinity of Tenino, Washington, have received a severe set-back in the definite admission of failure by the officials of the Crescent Oil Company. This concern drilled a well to a depth of 2136 feet, passing through four different strata showing indications of oil, but either because the water was not shut off properly, or because the sands themselves contained little oil, it was impossible to obtain even a semblance of actual production. This was the deepest well in the district, and work has been suspended on the others. Nevertheless, the Crescent well had neither reached the limit of profitable drilling as regards depth, nor a definitely unfavorable formation. Other fields, which are now good producers, have appeared just as unpromising at the start. While the outlook is decidedly unfavorable, it is too early to say definitely that the Tenino district will never become a producing oilfield.

MADDUX bill for the protection of oil-bearing sands in California from water-infiltration has become a law and Mr. R. P. McLaughlin has been appointed state oil and gas supervisor. This appointment is none the less welcome to those connected with the oil industry because it was to be expected. Mr. McLaughlin was for several years connected with the geological department of the Associated Oil Company, later entering private practice. For the past two or three years, he has devoted the greater part of his time to the management of the petroleum department of the State Mining Bureau. It was largely due to his efforts that the Maddux bill, the first really effective measure dealing with the water menace, was passed. In this, as in many other ways, Mr. McLaughlin has been able to perform signal service to the oil industry, and he has received the most satisfactory of all rewards of service; the opportunity to do still more, and to work more effectively.

EXPERIENCED deputies will be essential to the successful prosecution of the work of the department, and by the appointment of Messrs. M. J. Kirwan, E. B. Latham, R. B. Moran, and Chester Naramore, Mr. McLaughlin has made sure that there will be no trouble on that score. Messrs. Kirwan and Latham have been for several years past in the service of local associations of operators in the valley fields, and their new appointments do little more than make their previous work more effective. Messrs. Moran and Naramore have had wide experience in oil-production and are thoroughly acquainted with water-infiltration conditions throughout the State. With the object of starting the relations of the new department with the operators of the State upon the broadest co-operative basis, Mr. McLaughlin is now making a tour through the various fields, holding informal meetings with the oil-men at some central point in each field.

IRRIGATION possibilities in the Pit River basin, in the northeastern part of California, are discussed in a report by Messrs. W. F. McClure, state engineer of California, and E. G. Hopson, formerly engineer for the United States Reclamation Service. There is approximately 180,000 acres of irrigable land in the valleys

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along Pit river, of which 40% is now under ditch. The present production from the irrigated land is small, largely on account of lack of regulation of water supplies and poor drainage conditions. Complete development of the irrigable land in this region would reduce the low-water flow of the Sacramento river only about 8%, which would make no appreciable difference in the navigability of the stream. The report recommends improvement of transportation facilities by the extension of the McCloud River railroad to Alturas, and by the construction of new highways and the improvement of existing ones.

CONSERVATION of irrigating-water in Idaho is now more systematized than ever before. The precipitation throughout the southern part of the State has been unusually low during the past year and stream-flow and water in storage has decreased to such an extent that, taking into consideration the steady increase in the area dependent upon irrigation, the situation demanded energetic measures. These have been taken by the state engineer, acting under instructions from Governor Alexander. Water for domestic and stock purposes is to be assured to settlers without regard to priority rights as heretofore established. After these needs have been satisfied the remaining water is to be distributed in rotation for irrigation with regard to the actual needs of each farmer. No settler with a so-called vested right is to be allowed to waste water to the detriment of other irrigators. It is expected that with these regulations, the crop-loss will be reduced to a small amount. We earnestly hope that the resulting expense from litigation will also be small.

SIMON BENSON, good-road enthusiast, philanthropist, and incidentally capitalist of Portland, has been selected as the first citizen of the State of Oregon, and, as such, has been presented with a medal at the Panama-Pacific Exposition. Other once penniless immigrants have acquired fortune, and in some cases, fame, without obtaining the gratitude or even the good-will of the community in which they lived. Others have given liberally of their fortunes but nothing of themselves toward the advancement of the commonwealth. Mr. Benson's way has been different. The money that he has amassed has been freely given, together with his own talents, for the upbuilding of Portland and the State of Oregon. Of particular interest to engineers have been Mr. Benson's road-building activities. The Columbia River highway, which was recently completed from Gearhart to Portland, and will soon be finished to Hood river, is largely due to the efforts and the financial support of Mr. Benson and of another public-spirited citizen of Portland, Mr. John B. Yeon. These gentlemen, together with other good-roads men of Oregon, are now interested in furthering the proposed bond issue of $10,000,000 for the construction of a state system of permanent highways and it now seems probable that the question will be submitted to the voters at the next election, with every likelihood of their approval.

ROAD-IMPROVEMENT is becoming increasingly popular throughout California. As this issue goes to press, elections are being held in both Santa Barbara and Ventura counties on the question of voting bonds for the construction of a system of county highways. Kings county is just commencing the construction of a county highway system, while San Mateo, Monterey, Kern, San Bernardino, Riverside, and Orange counties are now at work on the construction of permanent highways, the funds in each case being obtained from the sale of bonds. Contra Costa county, on the other hand, has just started on a program of spending $100,000 from the general tax levy every year for ten years in the construction of concrete highways. More or less progress toward the submission to the voters of the question of the construction of a county highway system has been made in Sacramento, Santa Clara, Stanislaus, Merced, Fresno, and San Diego counties. Los Angeles and San Joaquin counties have already constructed highway systems, and there is a strong movement in the former county to issue bonds for additional highway construction. Work on the California state highway system under the original $18,000,000 bond issue is progressing, and there seems to be little doubt that the voters will approve the additional issue of $15,000,000 when the question is submitted. Adding the amounts appropriated by the different counties, the entire sum to be expended on permanent highways compares favorably with the $50,000,000 issue of the State of New York.

REGULATION of the torrential rivers of Los Angeles county is to be furthered by the newly-formed flood-control district including most of the area and nearly all the population of the county. These streams not only do considerable damage to agricultural land and to nearby cities, but also bring down enough silt nearly every winter to seriously interfere with the use of the patiently-constructed harbor of Los Angeles. A board of engineers composed of Messrs. F. H. Olmstead, J. B. Lippincott, H. Hawgood, Charles T. Leeds, and J. W. Reagan, has made a preliminary report on the works necessary for the protection of both the harbor and the land abutting on the streams. These works will include afforestation of the mountain slopes, reservoirs on the upper part of the streams and levees and other bank protection on the lower part, and a diversion channel carrying the entire discharge of the Los Angeles and San Gabriel rivers into Alamitos bay, where nobody minds a little silt anyway. The total estimated cost is $16,500,000, part of which it is hoped may be obtained from Federal and State sources and the remainder raised by forty-year bonds. A board of United States Army Engineers is now in Los Angeles, investigating the project with a view to determining whether the Government shall agree to the diversion of the rivers into Alamitos bay, and if so, whether it shall contribute toward the cost of this diversion, estimated at $5,500,000. Further action by the district will depend largely upon the decision of this board and of Congress.

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Materials of Construction for California State Highways

By CLARENCE B. OSBORNE*

CALIFORNIA, in November 1910, voted to spend $18,000,000 in the construction of two main highways the length of the State, and of lateral highways to connect the centres of population with the main routes. Some idea of the extent of this undertaking may be obtained when one considers that the distance from the Oregon boundary by way of the two great valleys to San Diego is over 800 miles. The area of California, besides water surfaces, is 158,360 square miles, 600 square miles greater than that of England, Scotland, Ireland, and Wales combined, with Maine, Delaware, and Rhode Island thrown in for good measure. The Highways Act provides for the construction of approximately 3000 miles of state highway, about 1800 miles of which may be called trunk lines, and the remainder laterals. The work is administered by a committee of the Advisory Board of the Department of Engineering, composed of Charles D. Blaney, chairman, Newell D. Darlington, and C. Frank Stern, known as the California Highway Commission. Austin B. Fletcher, highway engineer, is the executive officer in charge of the building of the highways.

No rigid standard of pavement was adopted by those in charge of the work. The plan has been, as far as possible, to have the pavement fit the traffic-needs, both as to type and width. The actual construction of the state highway has been in progress since the spring of 1912. At the present time, there is constructed or under contract 1180.1 miles of highway, classified as follows:

Type.	Mileage.
Graded only	305.9
Bituminous wearing surface on concrete base	800.4
Sheet asphalt on concrete base	20.9
Oiled macadam	19.1
Sheet asphalt (topeka) on macadam	16.5
Water-bound macadam	12.9
Concrete and timber trestles	4.4

This amount of highway required more than 1,100,000 tons of crushed rock or gravel, 500,000 tons of sand, 1,100,000 barrels of portland cement, and 80,000 barrels of road oil, not to mention corrugated-iron culverts, broken rock for masonry wall and riprap, asphalt, and other smaller items. The portland cement used has all come from California cement-plants, three of the mills being located in the vicinity of San Francisco bay, one on the coast near Santa Cruz, and two in southern California. This cement is sampled in the bins at the cement-plants and required to conform to the standard specifications for portland cement adopted by the American Society for Testing Materials, August 16, 1909, with subsequent amendments. The bins, after sampling, are held until the tests show that the cement meets these requirements. The cement is then released and can be drawn upon as needed. During the past year the construction work has been so heavy that a stock of from fifteen to twenty thousand barrels of tested cement has had to be kept constantly on hand at some mills in order to maintain a safe working margin.

The aggregate for concrete construction has been a greater problem than the cement. Because of the quantity used and its great weight, it cannot be drawn

PREPARING THE SUB-GRADE.

economically from a few central sources, but must be developed, as far as possible, at or near the work. This has necessitated a thorough prospecting of the local deposits of sand, rock, and gravel along the routes of the highway.

The investigation of concrete aggregates throughout the length of the state for this highway construction and the resulting development of local material will prove of great value, in the future, in the building of all kinds of concrete structures.

Before construction commences on any part of the highway a search is made for local supplies of concrete-aggregate. Those deposits that seem, on examination, to be of satisfactory material are sampled and these samples sent to the testing laboratory at Sacramento.

The samples of sand are sifted through the set of sieves, ranging from four meshes to the inch down to two-hundred meshes to the inch, in order to determine

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the mechanical analysis. The percentage of material passing the four-mesh and retained on the thirty-mesh sieve has generally been found to give an indication as to what can be expected of the sand when made into a cement mortar. The Commission's specification for sand requires that it shall contain not less than 50% and not more than 85% of material passing a four-mesh and retained on a thirty-mesh sieve. The actual value of the sample for use in concrete construction is determined by mixing a 1:3 mortar of the sand and cement and making cubes for compression and briquettes for tension tests. Mortar-cubes and briquettes of standard sand are made at the same time with the same lot of cement, and the strength of the sand under test is compared with the strength developed by the standard-sand mortar. The tests are made when the mortar is 7 and again when it is 28 days old. At the end of the 28-day test, mortars made of sand which are acceptable for concrete-highway construction show a greater tension-strength than the standard-sand mortar and a compressive strength in excess of 3000 lb. per square inch.

The sands are also tested for the proportion of voids, and of silt and organic matter. They are classified as to their mineral composition and the character of the grains, whether 'sharp,' 'medium,' or 'rounded.'

The laboratory has received some interesting sand-samples, among them a sand from the desert region that was pink, due to the large number of small red garnets it contained. Another sand, which had been brought down from Mt. Shasta by a living glacier, was composed of sharp fragments of volcanic glass. In some of the new country opened up by the highway, the sand bars about to be developed showed the fresh tracks of deer.

The need of over 1200 tons of coarse aggregate to the mile of highway has brought about the development of many gravel-pits and rock-quarries throughout the State. As is the case with the fine aggregate, before construction begins, the available supplies of coarse aggregate are sampled and these samples tested at the laboratory. The rock proposed for use is graded on sieves ranging from ¼-in. mesh to the maximum size of 2½-in. mesh. The concrete base of roads built with a protecting bituminous wearing-coat is not expected to resist the continuous abrasion of traffic. However, the Deval abrasion test as made by the Office of Good Roads, United States Department of Agriculture, has been found to give valuable information as to the strength of the rock to be used, and crushed-rock samples are tested for their coefficient of wear.

The coarse aggregate under test is made into a cement concrete, using a 1:2½:5 mixture, and cubes for compression tests are made of this concrete. At the end of 28 days, satisfactory aggregate for the highway pavement will show a compressive strength greater than 1500 lb. per square inch.

The gold-dredgers operating in the Sacramento valley have left great piles of hard igneous boulders. These boulders are the hardest parts of the andesite lava-flows which covered portions of the Sierra Nevada mountains, and have been carried by the streams, along with the fine gold and silt, to the great valley-floor. Soon after the commencement of state-highway construction, the commission arranged for the purchase of thousands of tons of these crushed boulders. This splendid supply of coarse aggregate was of importance in a region that lacked other adequate supply of suitable material in a large part of its area.

At this date the highway commission has constructed or now under contract over 800 miles of concrete pavement with a bituminous wearing-surface. This type of construction is used for the main routes where travel is heavy. Near San Francisco, and in some parts of southern California, where the traffic demands are unusually great, a concrete base 6 in. thick with a sheet asphalt or topeka asphalt wearing coat 1½ in. thick has been built. The concrete pavement with the bituminous wearing-surface is, as a rule, 15 ft. wide with stone or gravel shoulders that increase the traveled way to 21 feet.

The concrete is made slightly richer than a 1:2½:5 mixture. The base has a minimum thickness of four inches. The minimum thickness is used only in case the soil sub-base is such that it can be compacted into a dense, solid foundation by wetting and rolling. If the soil does not show sufficient firmness when rolled, the concrete pavement is made thicker than four inches. The concrete, as it is discharged from the mixer, is required to be of an even color and to show a thorough mixture of water, cement, sand, and rock, with no separation of the coarse from the fine aggregate. The consistency desired is such that considerable tamping is necessary to bring a thin film of water to the surface. The tamping is done with heavy iron-shod wooden tampers, which are built to conform to the crown of the road. The surface of the pavement is further smoothed with wooden floats.

The bituminous covering of the concrete pavement has made it unnecessary to insert expansion-joints in the concrete base. This has made the road smoother for travel. The pavement makes its own contraction-cracks, and these make no irregularity in the surface. The application of the bituminous surface covers these cracks so that they cannot even be seen. There have been some portions in the hot valley-region where the concrete has 'buckled,' because of lack of sufficient space for expansion, but this has not been formidable enough to necessitate the building of pavements with artificial expansion-joints.

The concrete base is cured under water or wet earth for ten days. As soon as the surface becomes hard it is kept wet by sprinkling. At the end of the first day the pavement is checked off by low earth dams, in the same way as a field that is to be irrigated. These shallow reservoirs are filled with water and kept filled for nine or ten days. If the soil alongside of the road is such that it will not make dams that will hold the water,

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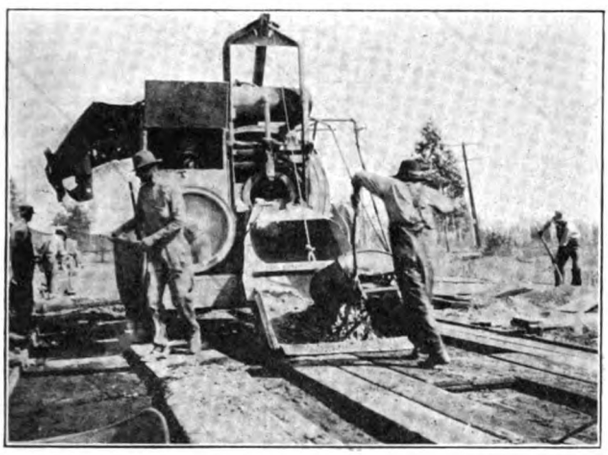
the pavement is covered with about two inches of earth and this earth kept wet. This 'irrigation-system' is the most satisfactory method of curing the concrete, because it is easy to see at a glance if the pavement is being properly cured. At the end of a month the pavement is cleaned with a street-grader and then opened to traffic for a month or two. The traffic breaks loose and wears away any weak film of *laitance* or other material that may have formed a thin coating on the surface of the concrete. If such a weak film covers the concrete at the time the bituminous wearing-coat is applied, the bitumen will not bind to the concrete, but will be separated from the base by this weak film. In such cases, the bituminous surface can easily be pulled loose from the concrete base. After traffic has been on the road the proper length of time, the concrete pavement is cleaned by sweeping with a street broom, and also if it is at all dusty, sweeping with steel brooms and house brooms is employed.

Road-oil that has been tested and found to conform



CHARGING THE MIXER.

to the specifications of the commission is then applied at the rate of ¼ gal. to the sq. yd. The oil is applied under pressure at a temperature of from 250 to 350° Fahrenheit. The oil surface is covered with screenings of hard, crushed rock or fine gravel. The screenings used will pass a circular-mesh opening having a diameter of ½ in., and are substantially free from dust. After the screenings have been sufficiently incorporated with the oil, the excess is swept into piles alongside of the road and the pavement given a second coat of oil with the same proportions, ¼ gal. per sq. yd. The surface is then covered with a second coat of screenings. The bituminous surface is then ready for traffic. During the first hot days after completion, further applications of screenings will be required on spots that show a tendency to 'bleed.'

With highways of this type there has been but little trouble due to the bituminous surface peeling off the concrete base. After exposure to heavy traffic for over two and one-half years on the first roads of this type constructed by the commission, the bituminous wearing surface is found to be giving good service. It is dull black in color. The road-oil binder is 'live' and takes care of any cuts made in the surface.

The road-oil used in the bituminous wearing coat is known on the Coast by the trade name of 90/80 road-oil, that is, it contains approximately 90% of asphalt of 80 penetration. The commission buys the oil in large

NEWLY-GRADED HIGHWAY IN HUMBOLDT COUNTY.

quantities. It is held in storage tanks, the tanks being sampled at regular intervals as they are filled. The samples are tested in the laboratory of the commission and the oil released to fill shipping-orders when the tests show it to be satisfactory.

The laboratory makes two physical tests of the oil that furnish information of especial value to the road-builder; one test for the viscosity to determine that the oil is not too 'hard,' and one test for its cementing value. In addition, the oil is tested for the percentage of 80 penetration asphalt, for chemical purity, and for freedom from foreign material. The testing laboratory tests the sands, asphalts, and dusts used in the sheet asphalt work in the same manner as adopted in the careful control of city pavements.

COMPLETED HIGHWAY NEAR SAN FRANCISCO.

Water carrying a noticeable amount of soluble minerals from springs or wells near the highway is at times desired for use in gauging cement-concrete. Before its use is allowed, neat-cement pats are made up with this water and these pats are boiled in the same kind of water when one day old. These pats are compared with pats made with, and boiled in pure water. This gives a delicate, accelerated test that has furnished better information in regard to questionable water, than a quantitative chemical analysis would do.

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Construction and Maintenance of San Joaquin County Highway System

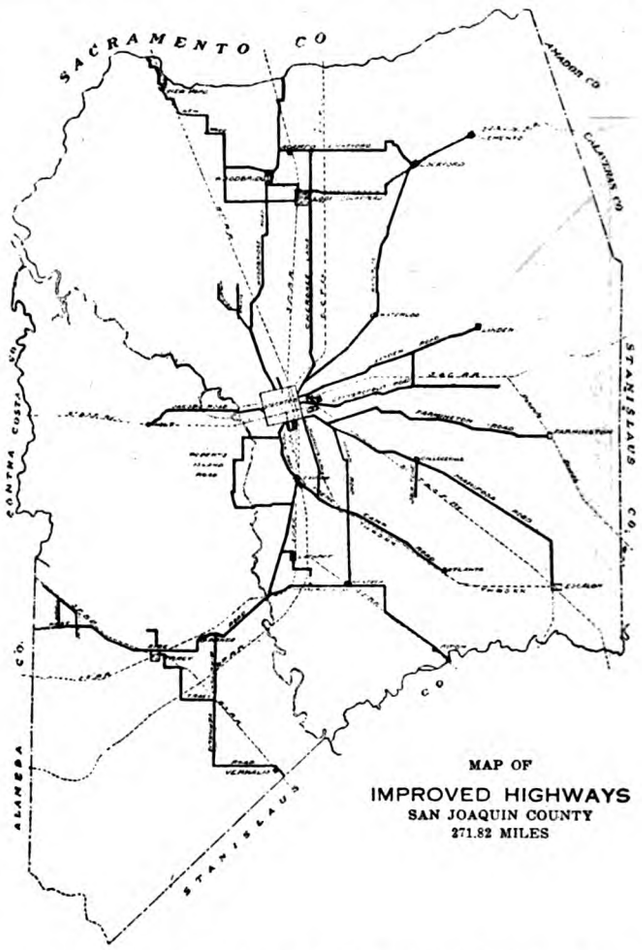
By F. E. QUAIL*

In the spring of 1909, the citizens of San Joaquin county, California, after a period of extremely bad road-conditions caused by the usual winter rains and the unimproved condition of the main highways, voted overwhelmingly to bond the county for $1,890,000 for the improvement of 240 miles of the main highways. The act under which the bond issue was voted, provided for the appointment of a highway commission of three members with power, subject to the general direction of the board of supervisors, to prepare plans and specifications, advertise for bids, and let contracts for the construction of highways and bridges. The first contract was awarded in October 1909.

The soils of the county over which the roads pass vary from a loose, sandy loam to a heavy adobe or stiff clay, the latter being almost impassable during the winter or rainy season. The type of road constructed was for the greater part oiled macadam, though some asphaltic macadam, concrete, and graveled roads were constructed. Various methods were used in building the oiled macadam, the most successful being described below.

Over the adobe soils, a 5-in. gravel base was constructed using a cementing road-gravel, while on the sandy soils, a 4-in. gravel or water-bound macadam base was constructed, depending upon the availability and cost of the material. In the construction of the water-bound macadam base, the sand-loam soil taken from the road was used as a filler to the crushed rock, and was found to give fully as good results as though rock screenings had been used, the resulting base being exceptionally firm.

When the base had been constructed, a wearing-surface was constructed by spreading a 2-in. layer of 1½-in. to ¾-in. crushed rock over the base, then rolling thoroughly and adding sufficient screenings to fill the voids in the rock wearing-surface to within about ¾ in. of the surface. The earth shoulders were brought to such a height that both shoulders and rock surface were uniform and to the required grade after being rolled. The rock surface was then watered to wash it clear of dust or dirt. After allowing it sufficient time to dry, an application of asphaltic oil was made at the rate of ¾ gal. per sq. yd. of surface. A pressure oiler was used to atomize the oil and distribute it evenly over every portion of the exposed rock surface. Enough stone chips or pea-gravel, ranging in size from ½ in. to ⅛ in. were then placed on the road to permit rolling without the oil sticking to the rolls. Stone chips or pea-gravel were added and swept over the surface to assist the roller in filling all voids in the rock surface. When rolled sufficiently, the surface was firm and would not creep under the action of rolling. All excess screenings were then swept from the surface and ½ gal. of oil per sq. yd. was applied and covered with rock screenings or coarse sand, preferably screenings carrying a low percentage of rock dust. This was thoroughly



broomed over every portion of the surface and well rolled. The road was then thrown open to travel. In some instances, after three weeks or more had elapsed, a third application of oil and screenings was used, the oil being applied at the rate of ⅛ gal. per square yard.

Experience has shown that best results are obtained by the use of the smallest amount of oil that will coat the individual rocks in the surface of the wearing course, and seal the surface. The oil used was a heavy asphaltic oil containing 80% of asphalt and was applied at a temperature of from 220° to 250°F. The maintenance department has found that the use of an oil carry-

*County surveyor and engineer of highway maintenance department of San Joaquin county, Stockton, California.

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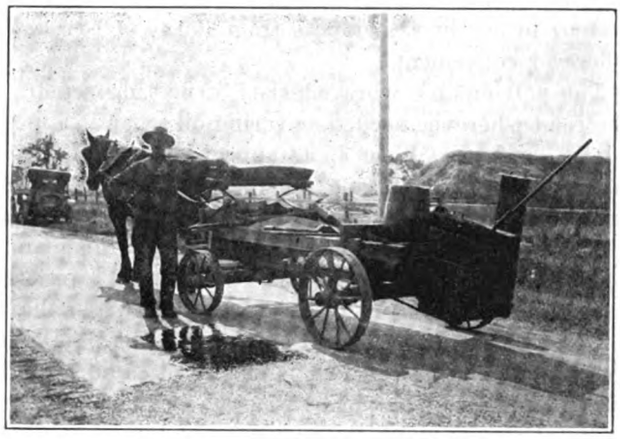
ing 90% of asphalt and applied at a temperature of from 300° to 350° will give much better results than that used in construction by the highway commission.

By January 1912, 120 miles of roads had been constructed and attention to maintenance was necessary. The law under which the money was raised and the roads built, provided that when constructed, they should pass back into the hands of the supervisors to be maintained by them from the general funds of the county. As the result that had been usually obtained

SHOWING EARTH SHOULDER IN NEED OF RENEWAL.

by boards of supervisors was in no way commensurable with the amount of money expended, and was otherwise unsatisfactory, the good roads club of the county, the highway commission, and the advisory board, after considerable discussion as to the methods of obtaining the best results in maintenance, decided to ask the board of supervisors to co-operate with them in devising a plan whereby the roads built at the expense of the people should be kept in the best condition possible with the funds available. A committee was appointed to recommend a plan and after due consideration, advised that the work of maintenance should be centralized under one head. They advised the appointment of the county surveyor to direct this work. The board of supervisors accordingly empowered him to organize a highway maintenance department and to purchase necessary equipment and install a system of accounting. He was also directed to render monthly report of expenditures, and a yearly report of the entire work.

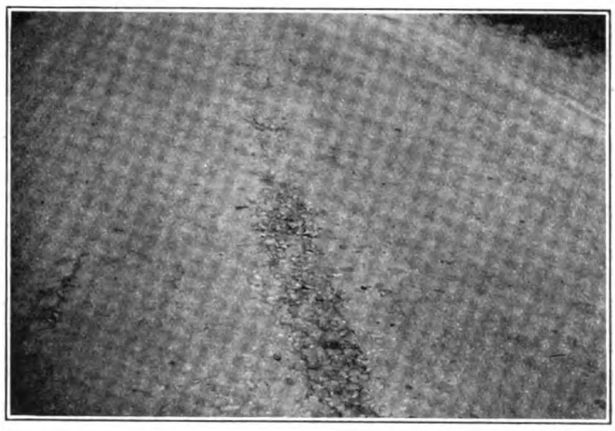
The system at present in the care of the department includes 325 miles of highway. This is constantly being increased as newly-constructed roads are completed and turned over for maintenance. The methods of maintenance vary with the character of the partic-



PATROLMAN AND OUTFIT.

ular road. In the organization of the department, the county surveyor is the official head with an assistant engineer directly responsible to him. The assistant engineer gives his entire attention to the work of the department. A second assistant and an accountant are under the direction of the first assistant.

The equipment of the department consists of road-rollers, motor-trucks, road-oilers, graders, scrapers,



WORK FOR PATROLMAN.

wagons, and other necessary machinery and tools to carry on the work. There is a central station where the implements are assembled when not in use and put in good repair, a shop being maintained for that purpose. The methods of conducting the work at present may be termed the 'one-man' patrol, gang system and motor patrol.

One-Man Patrol. Under this system, a patrolman is placed in charge of from twelve to fifteen miles of road. He is equipped with a horse and wagon, capable of carrying at least 2000 pounds, on which he carries

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material for making repairs, a 20-gal. oil-heating furnace, crushed rock, shovels, tampers, and other necessary tools, and a supply of asphaltic road-oil in five-gallon cans. A supply-tank of oil is placed at a convenient point of his patrol and is supplied from time to time from a central plant by motor-trucks. Crushed rock and pea-gravel are placed along the roads in piles of four to five tons, at points from 400 to 500 ft. apart, wherever convenient.

The patrolman's work consists of making repairs to the road wherever needed, covering oil when it appears on the surface. When spots appear where the sealing coat is worn off, exposing the rock, he sweeps the surface of the exposed rock clean, paints it with hot asphaltic oil, and covers it with screenings, in this manner keeping the sealing coat intact. With a little practice, an apt patrolman soon learns to make a patch that is hard to detect from the adjoining pavement. During the winter months, when it is not practicable to apply oil on account of the moisture, the patrolman attends to the drainage along the shoulders of his road to prevent water from standing and soaking into the subgrade, besides doing numerous other tasks that an energetic man finds are necessary to keep his patrol in good condition.

In fact, a good patrolman is a busy man. He is paid a monthly salary of $90, and must furnish his horse and wagon. Eight hours constitutes a days' work. He makes out a daily report showing the nature of work, the mile and the road worked upon and the materials used. These reports are sent to the office at the end of each week and are placed on file. The patrolmen are selected with a view to their efficiency, no political qualifications being necessary, except citizenship. They are placed on their honor and are directly responsible to the second assistant engineer, though their work is subject to inspection at any time, without notice, by the county surveyor or first assistant engineer. A patrolman is not expected to maintain his patrol in perfect condition at all times. When from faulty construction, excessive wear, or other causes, it becomes necessary to do more extensive work, a larger outfit is employed for the purpose.

Gang System. In this work, a number of men with road machinery are used. They are in charge of a superintendent, and might be called a 'construction-gang,' as they are equipped so as to be able either to build new roads or resurface and reconstruct such portions of old roads as need such attention. These gangs work during the dry season only, usually from May 1 to November 1.

Motor Patrol. The motor patrol consists of a three ton, gasoline truck fitted with a box-bed, carrying a 4 hp. steam-boiler for heating oil; a 250-gal. tank of road-oil and a pump with hose and spraying nozzle for applying oil. There is also a space six by eight feet for carrying material. The motor patrol is used at places that it has become impracticable for the patrolman to keep in repair, and where the use of the construction gang would hardly be justified, or where there is no patrolman. It requires four men to operate this outfit, a truck driver, oil-man, and two laborers, and the cost is approximately $14.20 per day. With this outfit, we are able to repair an average of one mile per day. We have also utilized prison labor to a considerable extent in our work. At present we are using two 1½-ton motor trucks with a driver and one guard in charge of from eight to twelve men. These gangs are used on various classes of work, sometimes as much as twenty miles from the county jail. A carefully kept record of the results of their work shows a great saving to the county from their use.

The greater part of the expense of the maintenance of our roads so far has been for reconstructing portions that were improperly constructed when first built and for widening pavements that were too narrow for the travel to which they were subjected. The cost of maintaining our roads for the past year was $283.00 per mile. This includes the cost of additions to the width, which should be in reality a betterment rather than a maintenance charge.

The first and second assistant engineers are each furnished with an auto runabout with which they can visit the men of the department at work in various sections of the county. They direct the various gangs at work and attend to the ordering of material and its distribution by motor truck to the supply points on the various roads.

Some of the chief troubles with which the department has had to contend in the maintenance of the oiled macadam roads, has been the tendency of the surface to become irregular and wavy, caused by the use of an excess of oil during construction and the application of too much fine material to absorb the oil as it comes to the surface. In some instances, we have overcome this by the use of a road plane, cutting off the high portions, and rolling ¾-in. and 1-in. rock into the surfacing material to give it more density and resistance. In many cases, we have had to scarify the entire wearing surface to incorporate the oil more thoroughly, then roll it and apply from ¼ to ⅛ gal. of oil with screenings to seal the surface. I will not attempt, however, to relate our experiences with the many problems of maintenance, hoping only that in a general way I have given you some idea of our work.

The benefit of such an organization as ours, equipped to do various classes of road work, has been recognized by our board of supervisors. Our department has been called upon at various times to do work, resulting in a substantial saving over bids submitted for performing the work by contract. As in other business organizations, careful selection of men and close attention to details, as well as the pursuance of a definitely outlined plan is required for the attainment of the greatest degree of success.

[Editor's Note.—There is now a strong movement in San Joaquin county to turn over the entire control of all county roads to Mr. Quail and his department.]

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The Los Angeles County Highway System

By F. H. JOYNER*

The first attempts to construct good roads were started in the year 1909, when the amount of $3,500,000 became available for that purpose. This was a bond issue authorized by an election held July 30, 1908, in accordance

ROLLING ROCK FOR NORWALK ROAD.

with the law of 1907, which authorized the construction and improvement of main public highways in any county by means of such bonds. The highways so improved are of oiled macadam from 6 to 8 in. thick on an 8-in. de-

OILING ROCK ON SANTA SUSANNA PASS ROAD.

composed-granite sub-base. The width is from 16 to 24 ft. The county provided the extra money, amounting to about $750,000 for the building of the excess over 16 ft., which was the limit of width allowed under the bond issue. For experimental purposes some miles of concrete roads has been built. The total length of permanent roads built under this bond issue was 299.22 miles. The following is a list of the roads improved under the bond issue:

No.	Name of road.	Miles.
1.	Santa Susanna Pass road	13.17
2.	San Fernando road	23.74
3.	Hollywood-Lankershim road	4.85
4.	Sunset boulevard	4.70
5.	Wilshire boulevard	6.85
5A.	San Vicente boulevard	1.77
6.	Washington boulevard	7.96
7.	Los Angeles-Inglewood and Hermosa Beach road	7.65
9.	Redondo-Wilmington road	6.63
10.	Harbor boulevard	11.33
11.	Palm avenue	0.39
12.	Slauson and Compton avenues	3.00
13.	Florence avenue	0.98
14.	Compton avenue	1.68
15.	Long Beach boulevard	12.47
16.	Compton-Clearwater road	2.79
17.	Valley boulevard	9.30
18.	Long Beach-Naples road	1.41
19.	Downey-Norwalk and Orange County line road	11.19
20.	Vernon-Downey road	7.70
21.	Telegraph-Laguna road	4.53
22.	Whittier road	14.12
23.	Pasadena avenue	1.68
24.	Monterey Pass road	4.62
25.	El Monte road	2.25
26.	Huntington drive	0.75
27.	Huntington drive	0.83
29.	Valley boulevard	16.61
30.	El Monte-Pomona road	19.39
31.	El Monte-Covina road	9.36
32.	Covina-Lordsburg road	6.91
33.	San Dimas avenue	0.97
34.	Foothill boulevard	19.03
35.	Citrus avenue	2.71
36.	Sierra Madre avenue	0.45
37.	Huntington drive	1.39
38.	Altadena drive	7.06
39.	La Canada-Verdugo road	5.82
40.	Eagle Rock road	0.75
41.	Mountain avenue	1.31
43.	Sixth street (Glendale)	0.27
45.	Clearwater Canyon road	0.97
46.	Falling Leaf avenue	1.38
47.	Lankershim boulevard	4.60
48.	National boulevard	4.08
49.	Pruess road and Pico street	2.58
50.	Van Nuys-Brand boulevard	0.98
51.	Workman avenue	2.27
52.	Canoga avenue	3.58
53.	Reseda avenue	3.33
54.	Sherman way	14.08
55.	South Sherman way	1.33
56.	North Sherman way	1.49
57.	East Sherman way	1.52
58.	Lankershim-Burbank road	3.37

*Road Commissioner, Los Angeles County, Los Angeles, California.

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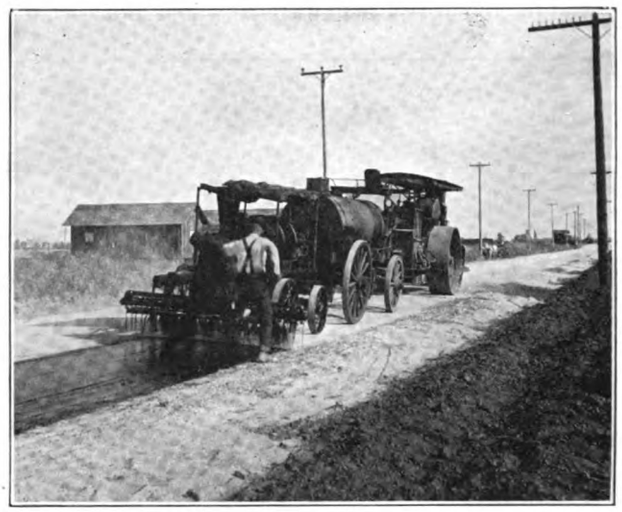
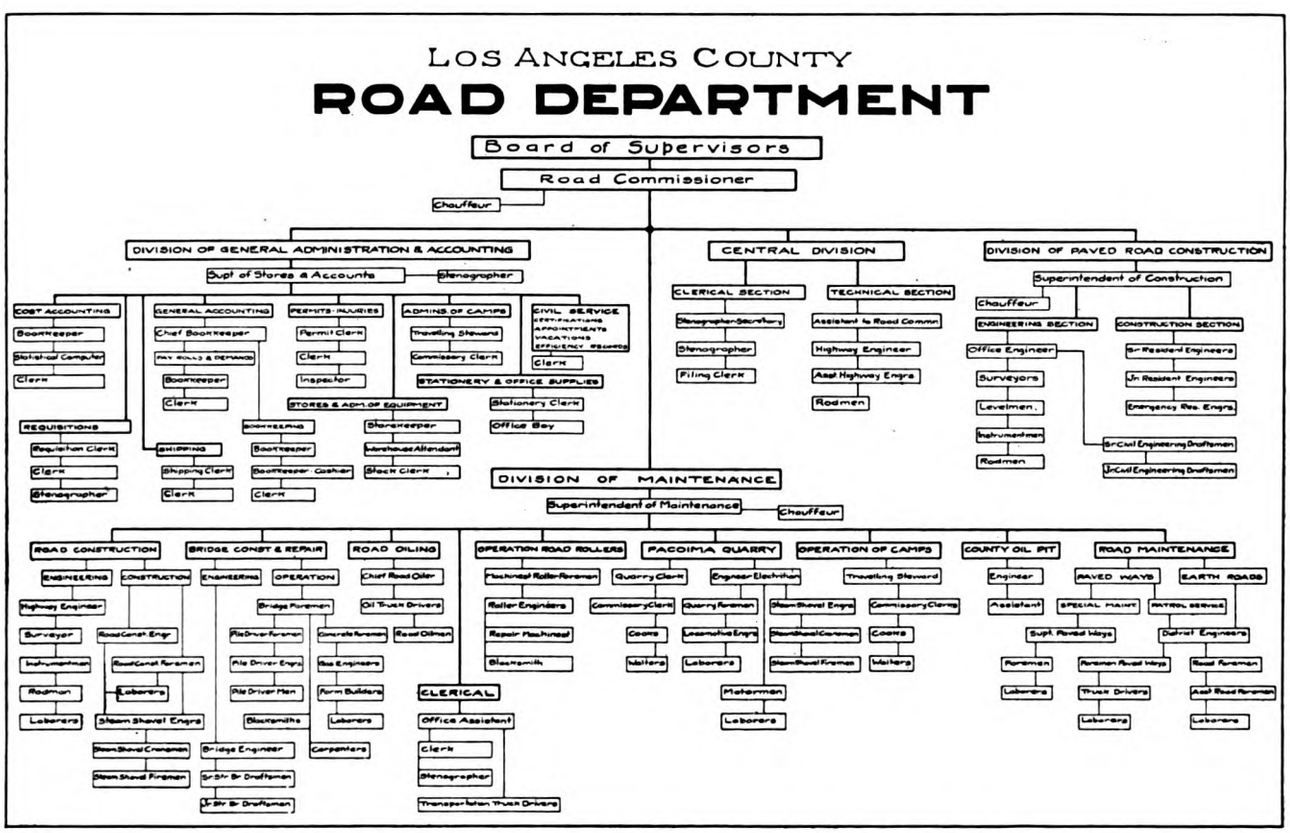
No.	Name of road.	Miles.
59.	Sunset boulevard	1.43
60.	Santa Monica boulevard	2.31
61.	Railroad avenue	2.39
62.	La Brea avenue	2.22
63.	Fourth street	0.59
64.	Nevada avenue	0.94
65.	Electric avenue	2.70
66.	Slauson avenue	0.74
67.	Nadeau avenue	1.00
68.	Hill avenue	0.74
69.	Cherry avenue	4.50
70.	Laguna-Florence road	0.70
71.	Durfee avenue (Mission-Temple road)	0.87
72.	San Gabriel-El Monte road	1.63
73.	Garey avenue (Pomona)	0.60
74.	Grand avenue (Lordsburg)	1.20
73.	Front street (Norwalk)	0.20
76.	San Vicente boulevard extension	0.22
77.	Cahuenga avenue	0.04
78.	Bell avenue	0.87
79.	San Antonio avenue, south	0.55
80.	Cataract street	0.25
81.	Section Center avenue	1.50
82.	Amelia avenue	0.50
83.	Covina street	1.00
84.	Exchange place	0.25
85.	Painter avenue	1.89
86.	Harrison avenue	0.25
88.	Verdugo road	1.06
90.	Williams street	0.86
91.	Wilshire boulevard (Soldiers' Home)	0.85
92.	Alameda street	...
95.	Palmdale-Lancaster road	...
96.	San Antonio avenue, north	1.00
97.	Section Center No. 2	1.00
100.	Colorado street and Rose avenue	0.79
101.	Lone Hill avenue	0.28
102.	La Ballona road	2.55
104.	Crescent avenue	2.18
105.	Grand avenue (Glendora)	1.00
106.	Tenth avenue extension (Puente)	...
107.	Woodbury road	0.52
108.	Doheny drive, Kings road, Flores street, Sweetzer avenue, Orange Grove avenue, Friend, Pacific avenue, Gardner avenue.	...
109.	Artesia and Anaheim road	...



OILING SURFACED ROAD.

In 1907 a statute was passed known as the 'Road District Improvement Act,' which authorized individual



ORGANIZATION DIAGRAM OF LOS ANGELES COUNTY ROAD DEPARTMENT.

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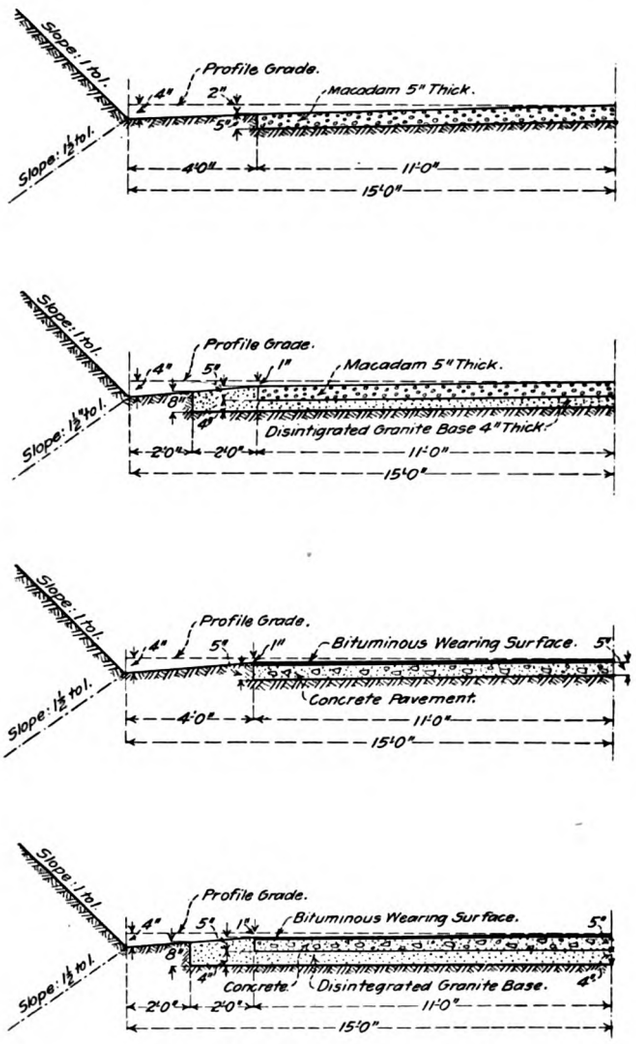

STANDARD SECTIONS OF IMPROVED ROADS.

property owners to combine and to establish local districts. Such districts have power to issue bonds for the improvement of parts of county roads within their limits. The county has been assisting the formation of these districts by promising to furnish broken stone and oil without expense to the districts. In this way the expenses of the districts include only the actual cost of engineering and labor. As a result of this policy, 38.14 miles of oiled macadam roads have so far been built in this manner, while there are 18.22 miles under construction. Petitions are out for 114 miles, on which the preliminary work is being done in the way of plans and specifications. Under the general laws of the State, 91.79 miles of macadam roads have been built and 9.52 miles are under construction, bringing the total amount improved by the county up to 429.15 miles, with 27.74 miles under construction. Following is a list of the roads constructed by improvement districts:

CONCRETE PAVEMENT ON CITRUS AVENUE.

MACADAM ROAD AFTER NINE MONTHS' USE.

No.	Name of road.	Miles.
5.	Colorado street	0.89
16.	New York avenue	2.00
17.	Passons boulevard	2.57
19.	Azusa street, Glendora avenue, etc.	5.60
20.	Center street, Somerset avenue, etc.	4.08
21.	Anaheim-Telegraph road	6.37
30.	Center street, Woodruff avenue	2.60
31.	Cypress avenue (Azusa street to Vicente street)	0.50
32.	Cypress avenue (Vicente street to Irwindale avenue)	0.50
33.	Wright road (Laguna)	1.59
34.	Lemon street, Olive street (Compton to Gardena)	2.49
35.	Olive street, Los Angeles and Redondo road	2.12
36.	Los Angeles and Redondo road, Gould lane	3.22
37.	.....	0.85
38.	Front, Main, Newton streets, etc. (Puente)	1.40
39.	Merced street	2.42
40.	Francisquito avenue	2.40
41.	Narbonne avenue	2.81
42.	Olive avenue, Pass avenue	3.79
43.	La Alameda, Bandini streets	0.53
44.	Anaheim street	1.00
45.	Western avenue	4.50
48.	West Adams street	2.36
53.	Fairmount way-Annandale	0.22
54.	Norwalk and Puente Mills road	3.62
55.	Vine avenue (Glendora avenue to Citrus street)	2.62
56.	Anaheim street	3.19
57.	.....	6.58
58.	Eagle Rock avenue	0.79
59.	6th street (Pacific to Grandview)	0.91

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	Exchange Place Colorado Street Pasadena Center Ave Amelia Avenue Covina " San Antonio " (South) John Pokaro—Contractor			Williams Ave. Harrison " San Antonio " (N) R.S. Mathews—Contractor			Painter Avenue Fred Hoffman—Contractor			Crescent Avenue D.D. Chapman—Contractor			La Ballona Road Rogers Bros. Contractors		
Nature of Work or Material	Quantity	Unit Price	Amount	Quantity	Unit Price	Amount	Quantity	Unit Price	Amount	Quantity	Unit Price	Amount	Quantity	Unit Price	Amount
1 Excavation (Cross Section)	8406 cyds.	.28	$2353.68	3591 cyds.	.23	$825.93	2566 cyds.	.35	$898.10	5916 cyds.	.28	1656.48	6242 cyds.	.40	$2496.92
2 " (Culverts)	1620 . .	.28	453.60	17 . .	.23	3.91	160 . .	.35	56.00						
3 " (Borrow)							200 . .	.35	70.00						
4 " (Ditch)							270 . .	.35	94.50						
5 Overhaul	3528 ½ yds.	.01	35.28				29,600 ½ yd.	.01	296.00				1200 ½ yds.	.01	12.00
6 Shaping Road bed	20,588 lin ft.	.08	1647.04	11,326 lin ft.	.08	906.08	10,000 lin ft.	.10	1000.00	11,423 lin ft.	.06	685.38	13,440 lin ft.	.02	268.80
7 Concrete - Class "A"	405 ½ cyds.	17.00	6864.80	2 cyds.	10.00	20.00	92 cyds.	13.00	1196.00	52½ cyds.	13.00	677.30			
8 Steel-Reinforcing Rods	24,590 lbs.	.05	1229.50				4700 lbs.	.05	235.00	902 lbs.	.05	45.10			
9 Reinforced Concrete Pipe	84'-18"	1.50	126.00	36'-18"	1.30	46.80									
10 Corr. Metal Pipe										84'-48"	5.00	420.00			
11 Guard Fence	260 lin ft.	.40	104.00												
12 File Trestle										2-19' Span		2250.00			
13 Crushing Rock	14,962 Tons	.90	13,465.80												
14 Placing Rock	14,962 "	.75	11,221.50				7072 Tons	.80	5,657.60	8377 Tons	.58	4991.18	9599 Tons	.69	6,623.31
15 Crushing & Placing Rock				8206 Tons	1.35	11,078.10									
16 Disintegrated Granite Base							2266 Tons	.60	1,359.60	1421 Tons	.54	767.34			
Total Amt. Contract Price			$35,501.20			$12,880.82			$10,862.80			$11,492.78			$9,401.43
Cost of Rock & Granite furnished by Co.									4,809.70			4,543.75			4,319.55
" " Oil " " "			665.00			582.00			480.00			668.00			782.00
" " Freight on Rock & Granite									4669.00			2939.40			4799.50
" " Engineering & Sup.			1297.40			1132.76			862.79			760.00			619.78
Grand Total			$37,463.60			$14,595.58			$21,684.29			$20,403.93			$19,921.86
Total Number of Miles	3.899 mi.			2.145 mi.			1.892 mi.			2.163 mi.			2.545 mi.		
" Cost per Mile			$9,608.51			$6,804.47			$11,461.04			$9,433.16			$7,827.88
" " " Solid Pave (including shoulders, culverts & trestles etc.)		.714			.527			.887			.731			.606	

COST-DATA ON RECENTLY CONSTRUCTED ROADS.

No.	Name of road.	Miles.
60.	Orr and Day road	2.93
61.	Artesia avenue	1.50
62.	Bairdstown	1.24
63.	Tenth street and Grand View avenue	2.21
64.	Irwindale and Orange avenue	4.37
65.	Tuna Canyon road	3.20
67.	Norwalk-Puente Mills road, Los Angeles and San Diego	6.94
68.	San Bernardino road, Grand avenue	2.32
69.	Topeka street, Main street (Rivera)	0.57
70.	Cerritos avenue, College road. No. 2	3.56
71.	Azusa street, Cypress avenue	2.01
72.	Western avenue	2.00
73.	Citrus avenue (Covina)	1.62
76.	Azusa avenue	1.27
77.	Mesa drive (Hyde Park)	2.00
78.	Roy avenue and Texas street (La Canada)	1.28
79.	Pacific avenue	0.82
80.	Central avenue	0.74
81.	Kenneth road	1.30
82.	Van Nuys	14.40
84.	Road northeast of Lancaster	19.00
86.	School street (La Canada)	1.00
87.	Barranca street	1.40
88.	Streets bounded by Indiana, Third, Hubbard and Laguna streets	3.80
91.	Town of Palms	8.42
92.	Whittier avenue (Montebello)	1.40

The construction of new roads, as well as the maintenance of the existing good roads and all other highways and roads is in charge of the county road department. This was created as a separate department under the direction of a road commissioner. The road department has been in existence since April 1914. It is now operating two stone quarries and crushing plants, providing most of the crushed rock needed for construction and maintenance purposes. The department has four steam-shovels, 15 steam or gasoline rollers, and three traction engines, converted to steam rollers, nine motor trucks, three motor trucks for oiling roads, besides concrete-mixers, pile-drivers, road-graders, and other implements and equipment for ordinary road work. The department has one central oil-pit for the storage and distribution of road-oil, together with a heating-plant. In connection with this central pit, there are several smaller storage-pits with portable heating-plants. The department now has a cement plant under operation, which may open the way to the construction of concrete roads at a moderate price in the future. There is a movement now under way for another bond issue of $3,000,000 for further highway construction and improvement.

The United States Coast and Geodetic Survey has issued a new edition of the Planefable Manual, which, besides describing the use of the planetable, is a practical treatise on topographic surveying. It is a reprint of Appendix No. 8 to the annual report of the Coast and Geodetic Survey for 1898, the only change being in the illustrations of topographic symbols, which have been modified to accord with those recently adopted. There is a full description of the planetable and its accessories, and of the methods usually followed in topographic surveys. There has been a large demand for this publication. It may be obtained from the Division of Publications, Department of Commerce.

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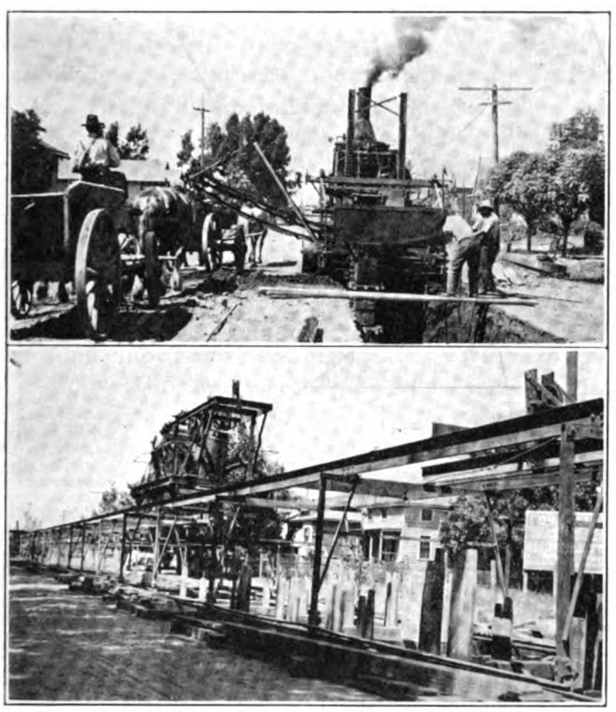
Construction of Sewer-System for Annexed District of Sacramento

By CARL MAUGHMER*

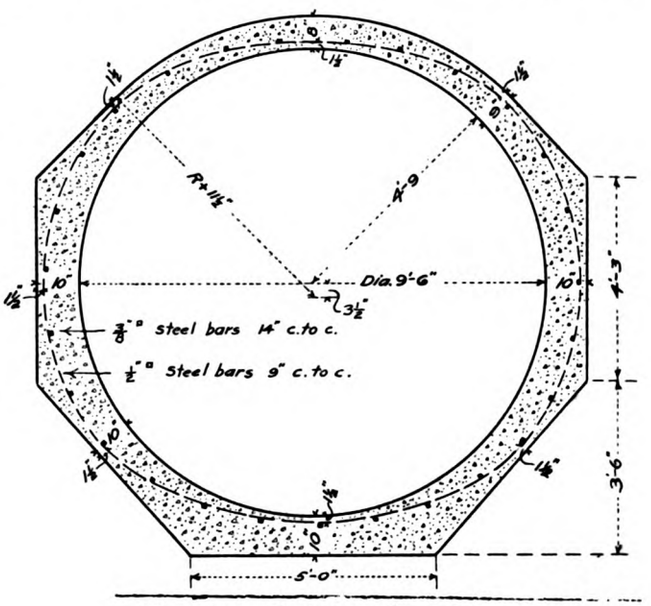
In September, 1911, Sacramento annexed a territory of approximately 6019 acres. As this section is building up rapidly, it became necessary to provide sewers for domestic sewage and drainage. A comprehensive system to meet needs as far in the future as 1940 was planned. A bond issue of $1,032,000 was later voted for the purpose and the system is now under construction.

A combined system is being constructed. All sewer sections are circular. Sewers having a greater diameter than 24 in., are of reinforced concrete. The largest sewer is 9½ ft. in diameter. On one contract, reinforced-concrete pipe is being used for sizes from 27 to 39 in. in diameter. The bond issue provides for sewers down to 20 in. diam. Funds for the construction of smaller sewers will be provided by forming assessment districts. In most cases, catch-basins will not be used, the gutter-drains being connected direct to the sewers. The grades are such that the velocity running full varies from 2.3 ft. per second at the upper ends of the laterals to 4.1 ft. per second at the outfall. Changes in direction are made with curves, the radius varying from four to eight times the diameter of the sewer.



PARSONS DITCHER AND POTTER TRENCHING-MACHINE.

The sewage will be disposed of by dispersion in the Sacramento river, into which it is pumped by low-lift centrifugal pumps. Five Worthington vertical centrifugal pumps will be used, three having a capacity of 40,000,000 gallons per day, and two having a capacity of 12,000,000 gallons per day. Provision is made in the pumping station for three more pumps of 40,000,000 gallons capacity. The pumps are driven by direct-connected electric motors manufactured by the General Electric Company and are placed on the second floor of the pumping-station, so as to be above any possible flood that might occur. At high stages of the river, the pumps will work against a head of 25 to 30 ft. The outfall discharge-pipe is of reinforced-concrete 7½ ft. in diameter, provided with an hydraulic-operated floodgate which can be controlled either from the pumping-station or from the gate-house.



Section of 114 inch sewer

In the original project, a scheme of treatment of the sewage prior to its discharge into the Sacramento river was proposed, comprising clarification in Imhoff tanks with subsequent sterilization, followed as the burden on the river became greater, by oxidation. However, the fact that the Sacramento river above the outfall is already polluted and that the dilution will be ample to prevent local nuisance for many years to come, led the State Board of Health to grant a revocable permit curtailing treatment to removal of unsightly solids. For this purpose, automatically cleaned bar-screens, built of ¼-in. rods, ¾ in. centres are provided. For flushing the main trunk-line sewers in the dry season, blow-offs from the water mains will be constructed, these being mainly 4 in. and 6 in. diameter. At McKinley Park, a 36-in. lateral, running into a lake, will be utilized for flushing the main trunk-sewer, which runs along 31st street.

*Assistant City Engineer, Sacramento, California.

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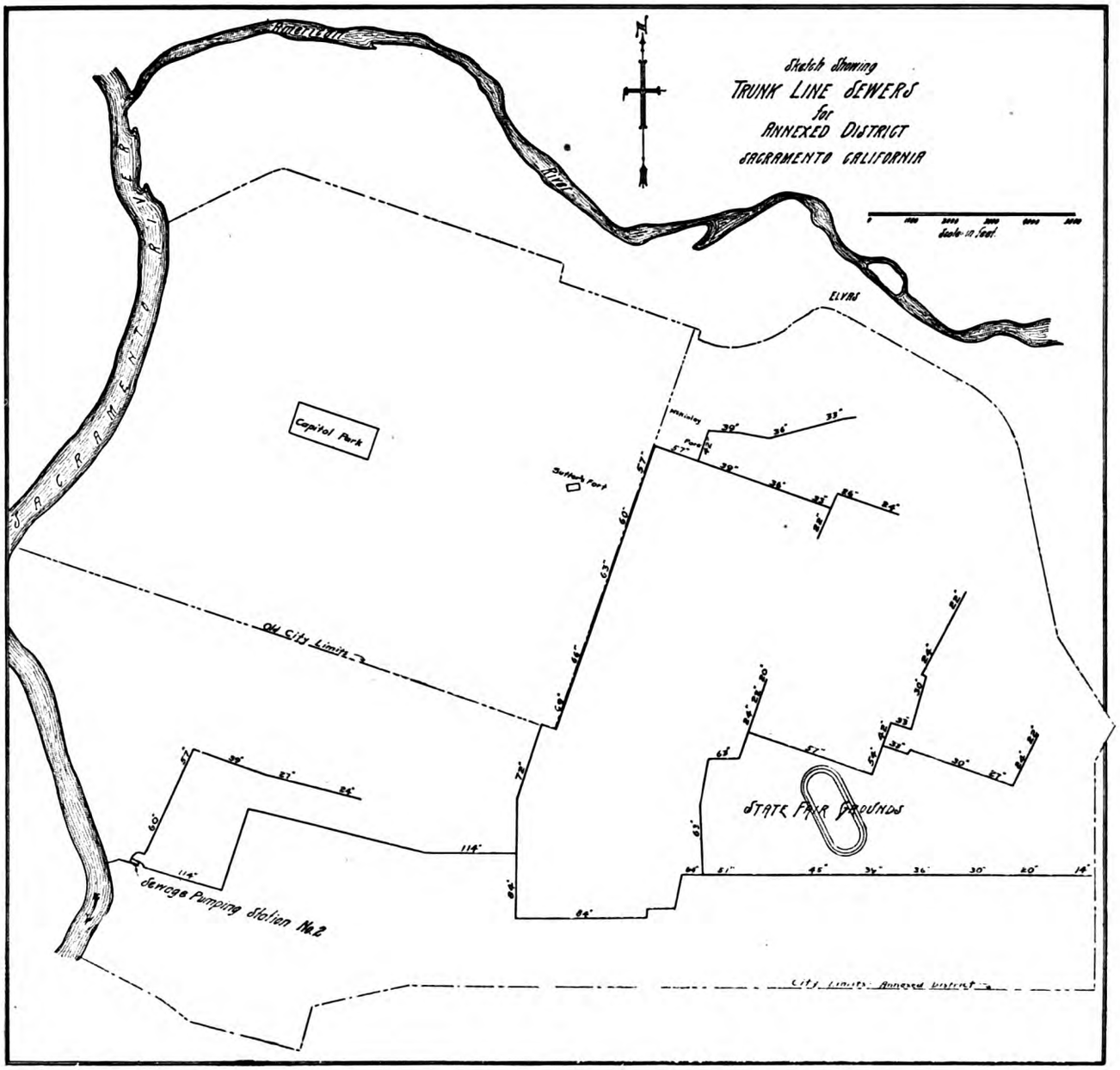

For the purpose of construction, the system was divided into seven units and these in turn into sections. Several types of excavating machinery are being used in the construction work, including a Marion steam-shovel with a one-yard bucket, two Potter trench machines, two Parsons tractor ditchers, a Keystone excavator, and a traveling derrick with orange-peel bucket. Little sheeting has been used so far, although in some cases it is necessary to lay sub-drains and to pump considerable seepage-water. Where the sides of the trench are soft and yielding and will not take the shape of the lower section of the pipe, the bottom width of the concrete is increased by carrying the sides vertically to the bottom. Wooden forms are being used except on reinforced-concrete jointed pipe.

The contracts awarded up to August 1, 1915, are as follows:

Outfall sewer and appurtenances, J. W. Terrill, Sacramento	$21,950.00
Pumping station building, Teichert & Ambrose	40,880.95
Pumping machinery, Power Equipment Company, San Francisco	40,210.00
Unit No. 1, Ross Construction Company, Sacramento	53,877.00
Unit No. 2, Sections A and C, Clinton Fireproofing Company of California, San Francisco	92,192.30
Unit No. 3, James Kennedy, Los Angeles	81,052.48
Unit No. 4, James Kennedy, Los Angeles	37,280.40
Unit No. 5, James Kennedy, Los Angeles	104,912.68
Unit No. 6, Sections A, C, and D, A. Teichert & Son, Sacramento	71,476.25
Low line, Unit No. 1, Mathews Construction Company	42,460.03

The work is being carried out under the direction of Thomas Coulter, commissioner of public works, and Frank C. Miller, city engineer, with Geo. J. Calder in resident charge of work, and myself in charge of design and office work.

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Road Construction in the Philippine Islands

The *Standard Oil Bulletin* contains an account of road-building among the Igorot tribes of northern Luzon. The civilizing influence of good roads is proverbial, and it is evident that this influence was particularly valuable in the Philippine Islands. The practice of head-hunting among the savage peoples of northern Luzon was a serious problem for the early American administrators in the Philippines. Here were half a million savages inhabiting a region so rugged and broken that only by cutting terraces on the mountain sides could they secure flat ground upon which to grow their crops. On these terraces the women and children struggled with nature for their sustenance, while on the crags, and in the mountain gaps, and on the edge of the clearings, the men stood guard. The taking of a head was the ambition of the young man's life; it was the joy of his woman. Not only did one people fight against another, but town against town. They were enemies because they were unaware of their neighbor's virtues. There were no roads, there were no channels of trade. The people knew almost nothing of peaceful barter. On those steep mountain sides men met only over the shield's edge and the spear's point. Opportunity for peaceful intercourse had to be created before there could be hope of peace.

A policy of trail building was inaugurated. Making small beginnings on the border, the trails were pushed farther and farther back, then across to each other. At first difficulty was experienced in persuading the wild men to work, but by dint of much labor, and with sympathetic understanding, yet with firmness, the American pioneer gradually taught them. Then came the problem of putting men from hostile towns on the same job. Its solution found people who but a short time before were blood enemies, working shoulder to shoulder in the building of highways over which they and their families now pass unmolested and happy. They now see each other's point of view, recognize common interests as well as a savage can, and the Government is in position to forge ahead in the slow process of leading these benighted yet promising peoples into the light of civilization. While awakening to the many benefits they now enjoy under Governmental control, the erstwhile head-hunters are also learning the duties and obligations of citizenship, as each man gives ten day's labor every year on the trails. Though from trails to roads is but a step, in some countries it is a step delayed for centuries. Many miles of trails have been broadened, and carts and wagons now penetrate into the heart of the country. Even the 'chug' of the motor is heard in those valleys, which, less than a decade ago, were theatres of constant and bloody warfare.

In the islands the enthusiasm of these primitive peoples for good roads is exceeded only by that of the Christianized Filipinos. But they, too, had to be converted to the gospel of road-building. While a few good roads had been built, during the Spanish occupation, they were neglected during the troublous times of the early part of American administration. Conditions were such that it was not until 1904 that constructive work could be begun, when road-building was inaugurated by the Insular government. Experience soon proved that unless the Filipinos were made responsible, not only for the construction of a road, but also for its maintenance, its building was useless.

At present, not a mile of road is built until arrangements have been made for its maintenance by the local people. Some idea of their desire for good roads may be gleaned from the fact that several years ago every one of the Christian provincial councils voluntarily doubled the poll-tax rate for the purpose of securing the increased income for road-work.

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PREPARING GRADE FOR MOUNTAIN ROAD.

There are now 5000 miles of good roads in the Philippines. During the rainy season on every first-class road of this remarkable system a *caminero* or road-man, is assigned to every half mile, and during the remainder of the year to every mile. Stocks of repair material are kept under regulation at certain points and periodically renewed. Concrete posts mark the kilometer, the metric system being the rule in the Philippines, and every kilometer is carefully inspected weekly, monthly, and annually by the various officials.

Program of the Pan-American Road Congress

The advance program of the Pan-American Road Congress, which is to meet in Oakland, September 13-17, has recently been issued. Besides the American Highway Association and the American Road Builders' Association, the two organizations originally joining in the Congress, the Tri-State Good Roads Association has changed its date of meeting to September 13, and the Pacific Highway Association its meeting to September 16, thus insuring the co-operation of all four bodies for the success of the Congress. Except for the afternoon session on September 15, which will be held in Festival Hall on the Exposition Grounds, the meetings will be held in the municipal auditorium at Oakland. The office of the Congress will be at the headquarters room of the auditorium building and will be open from 9 a.m., to 5 p.m. for registration and other business connected with the Congress. The executive committee of the Congress is composed of Charles W. Gates, Franklin, Vermont, chairman; W. W. Crosby, Baltimore, Maryland; James H. McDonald, New Haven, Connecticut; J. E. Pennybacker, Washington, D. C.; E. L. Powers, New York City; and Charles F. Stern, San Francisco, California, western representative. September 15 has been designated as Pan-American Road Congress Day at the Exposition. Special trains have been provided for the Eastern delegates both going to, and returning from the Exposition, and there will be an automobile excursion on September 18. The program, as far as determined, follows:

FORMAL OPENING

MONDAY, September 13, 10.30 a.m.

Charles W. Gates, governor of Vermont, presiding.

INVOCATION.

Opening Address—Charles W. Gates, governor of Vermont.

Address by Hiram W. Johnson, governor of California.

Address by Ernest Lister, governor of Washington.

Address by James Withycombe, governor of Oregon.

Address by John L. Davie, mayor of Oakland.

Address by James A. Barr, director of congresses, Panama-Pacific International Exposition.

Address by G. W. Tillson, president, American Road Builder's Association.

Address by Fairfax Harrison, president, American Highway Association.

Appointment of committees.

FIRST SESSION

2:00 p.m.

Fairfax Harrison, president, American Highway Association, presiding.

The History and Future of Highway Improvement.

L. W. Page, director, Office of Public Roads, U. S. Department of Agriculture.

The Relation of the Road to Rail and Water Transportation.

The Benefits and Burdens of Better Roads.

S. E. Bradt, secretary, State Highway Commission, Illinois.

Roadside Improvement.

Paper by Henry S. Graves, chief, Bureau of Forestry, U. S. Department of Agriculture.

The Essentials of Proper Laws for Highway Work.

E. A. Stevens, state highway commissioner, New Jersey.

A. N. Johnson, highway engineer, Bureau of Municipal Research, New York City.

National, State, and Local Responsibility for Road Conditions and Ways of Securing Improvements.

J. T. Ronald, Seattle, Washington.

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TUESDAY, September 14.

10:00 a.m.

George W. Tillson, president, American Road Builders' Association, presiding.

Proper Road Location: Its Importance and Effects.

Paper by William R. Roy, state highway commissioner, Washington.

Discussion opened by Paul D. Sargent, chief engineer, state highway commission, Maine, and W. F. McClure, state engineer, California.

Road Drainage and Foundation.

Paper by Geo. W. Cooley, state highway commissioner, Minnesota.

Discussion opened by R. K. Compton, chairman of paving commission, Baltimore, Maryland.

Highway Bridges and Structures.

Paper by W. S. Gearhart, state highway commissioner, Kansas.

Discussion opened by Clifford Older, bridge engineer, state highway department, Illinois.

2:00 p.m.

Walter Coggeshall, president, Tri-State Good Roads Association, presiding.

Highway Indebtedness: Its Limitation and Regulation.

Paper by Nelson P. Lewis, chief engineer, board of estimate and apportionment, New York City.

Discussion opened by J. F. Witt, Dallas, Texas, W. I. Vawter, Medford, Oregon, and B. A. Towne, Lodi, California.

Organization and System in Highway Work.

Paper by A. B. Fletcher, chief engineer, state highway commission, California.

Discussion opened by H. R. Carter, state highway engineer, Arkansas, and by C. D. Blaney, chairman of state highway commission, California.

The Educational Field for Highway Departments.

Paper by L. S. Smith, department of highway engineering, University of Wisconsin.

Discussion opened by A. D. Williams, chief road engineer, West Virginia.

WEDNESDAY, September 15.

PAN-AMERICAN ROAD CONGRESS DAY

MORNING SESSION IN OAKLAND.

10:00 a.m.

W. A. McLean, chief engineer, Ontario highway commission, presiding.

Roadway Surfacings.

Paper by F. F. Rogers, state highway commissioner, Michigan.

Discussion opened by E. R. Morgan, road engineer, state road commission, Utah.

Resurfacing Old Roads.

Paper by W. D. Uhler, chief engineer, state highway department, Pennsylvania.

Street Pavements.

Paper by Curtis Hill, city engineer, Kansas City, Missouri.

Discussion opened by M. M. O'Shaughnessy, city engineer, San Francisco, California.

AFTERNOON SESSION IN FESTIVAL HALL, PANAMA-PACIFIC EXPOSITION.

2:30 p.m.

W. S. Worden, treasurer, Tri-State Good Roads Association, presiding.

System in Highway Accounting.

Paper by S. D. Gilbert, auditor, state highway commission, New York.

Discussion opened by A. R. Hirst, highway engineer, state highway department, Wisconsin.

Uniformity for Highway Statistics and Data.

Paper by H. E. Breed, first deputy, state highway commission, New York.

Engineering Supervision for Highway Work.

Paper by T. W. MacDonald, state highway commissioner, Iowa.

Discussion opened by Lamar Cobb, state engineer, Arizona, and by Prevost Hubbard, chief of division of road material tests and research, U. S. Department of Agriculture.

THURSDAY, September 16.

10:00 a.m.

James H. MacDonald, former highway commissioner, Connecticut, presiding.

The Merit System in Highway Work.

Paper by Richard Henry Dana, president United States Civil Service Reform League.

Discussion opened by J. H. Pratt, state geologist, North Carolina.

The Determination of the Justifiable Outlay for Specific Cases of Highway Improvement.

Paper by Clifford Richardson, New York City.

Discussion opened by Henry Welles Durham, formerly highway engineer, Borough of Manhattan, New York City.

Convict Labor for Highway Work.

Paper by G. P. Coleman, state highway commissioner, Virginia.

Discussion opened by J. E. Maloney, secretary and engineer, state highway commission, Colorado.

Report of Committee on Resolutions.

2:00 p.m.

John A. Wilson, president, American Automobile Association, presiding.

Motor Traffic: Its Development, Trend, and Effects.

Paper by Elmer Thompson, secretary, Automobile Club of America.

Discussion opened by Warren Gould, chairman Automobile Club, Seattle, Washington, and W. G. Chanslor, San Francisco.

Equipment for Highway.

Paper by A. H. Blanchard, department of highway engineering, Columbia University.

Discussion opened by H. J. Kuelling, county highway commissioner, Wisconsin.

Load and Tire Effect and Regulation.

Paper by F. H. Joyner, road commissioner, Los Angeles county, California.

Discussion opened by T. R. Agg, University of Iowa.

FRIDAY, September 17.

10:00 a.m.

W. D. Sohier, chairman of Massachusetts highway commission, presiding.

Comparisons of Traffic and Their Economic Value.

Maintenance, Materials, and Methods.

Paper by A. W. Dean, chief engineer, state highway commission, Massachusetts.

Dust Suppression and Street Cleaning.

Paper by W. H. Connell, chief of highway bureau, Philadelphia, Pennsylvania.

Discussion opened by Perry Brown, city engineer, Oakland.

CLOSING SESSION

2:00 p.m.

Charles W. Gates, presiding.

Lessons of the Congress.

Paper by Charles F. Stern, member of state highway commission, California.

Unfinished Business.

Reports of Committees.

Adjournment.

When gas or water pipe has to be disconnected frequently or the arrangement changed, it should be provided with a number of unions or else with cast-iron fittings. The latter are easily broken by a sharp blow of a hammer without injuring the thread. This may be thought a destructive method, but the time saved is often worth more than the fittings destroyed.—*The Gas Engine.*

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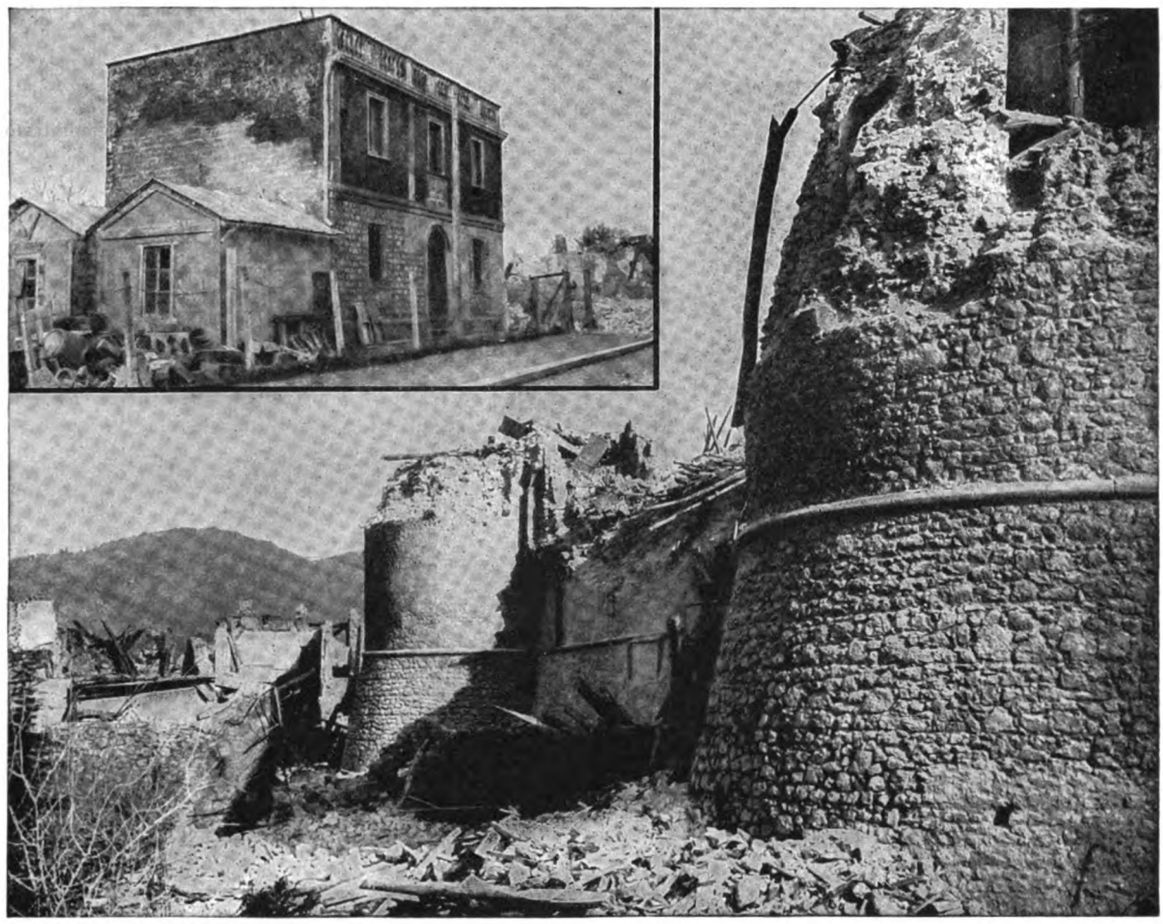

Reinforced Concrete Building Which Withstood the Italian Earthquake*

The ability of reinforced concrete to withstand extraordinary strains is well illustrated by the earthquake catastrophe occurring in Italy last January. The accompanying photographs show the comparative resistance of old and modern methods of construction. Reinforced concrete carried off first honors. Avezzano, where these photographs were taken, was destroyed in eight seconds. Of 11,000 people in Avezzano and Capella only 300 were saved. Every building with one exception was destroyed by the earthquake. This was built of reinforced concrete and the walls were not even cracked. The photograph shows the building after the earthquake. Among the ruins was the interesting old Orsini castle which was built in the year 1400. This ancient castle has walls six feet thick, built with all the conscientious care of the skilled mason; yet the shock of the earthquake reduced them to a mass of ruins. The contrast with the comparatively light reinforced-concrete construction shown in the other photograph is remarkable.

The experience in Italy only confirms the similar experiences encountered in earthquakes at San Francisco, Messina and Jamaica. In all these places reinforced concrete has demonstrated that its resistance to earthquake shocks is far superior to any other type of construction. In San Francisco it was a reinforced-concrete warehouse of the Kahn system of construction that withstood the earthquake without a sign of a crack. In Jamaica the results were similar. This is the reason why in the rebuilding of these stricken districts, reinforced concrete has played the most important part and constitutes the bulk of all the new permanent constructions. Reinforced concrete has earned its success under the strenuous test of shock and fire.

*From *Modern Building.*

A new system of illumination for subway cars has been adopted by the New York Municipal Railway. The head-lining and walls down to the window sills will be enameled white, so as to provide reflecting surfaces. Bowl-frosted tungsten lights will be used, arranged in a single row along the centre line of the ceiling. The cars are 9 ft. wide inside and 65 ft. long, and there will be 15 of these 56-watt tungsten lamps supported in 6-in. opal reflectors. The effect of this illumination is to give a soft and uniformly distributed light. The power-consumption of this illumination will amount to under 1.5 watt per square foot.—*Mechanical World.*

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Street Paving in California

Progress in methods of street construction in California will be of interest to engineers and others who will take part in the 1915 road congress to be held in Oakland.

Conditions in California differ in many respects from those in other states. This is due principally to the climatic conditions, strange and wonderfully constructed street laws, and to local industries that affect materials for construction.

One of the conditions intimately affecting street work in all communities, is the laws governing street work. Perhaps no state in the Union, except Texas with its homestead exemptions, presents such legal conditions as exist in California. No statute providing for street improvements has ever been so strangely and wonderfully constructed as the 'Vrooman' Act of this state, named for one of its sponsors. This statute was first enacted in 1885. It has since been amended, revised, and re-amended, and the amendments amended at nearly every session of the Legislature, until now it encumbers, with its verbiage, 125 pages of the Civil Code. Millions of words have been uttered in court and printed in the law reports, aggregating many volumes of Court decisions, in a vain attempt by the Courts to determine the intentions of the law-makers. One of the leading officers of the State League of Municipalities has said that some three thousand decisions have been rendered by the Courts, so complicating the meaning of this statute that it now resembles more closely a patchwork quilt than any other object.

Under its provisions, cities do not contract direct for street improvements, but instead, delegate the making of a contract to the so-called Superintendent of Streets, who in the smaller cities generally manipulates the broom at the crossings. No responsibility whatever for payment legally attaches to the city. Such a state of affairs has been reached in the operation of this law that, on technicalities so minute that no one could recognize them except a Supreme Court justice with a microscope, contractors, who have made their bids and accepted contracts in accordance with the call for bids by municipalities, have completed their work in accordance with specifications adopted and made a part of their contract by the municipalities; have received the symbols of special assessment indebtedness of the property owners; in the end find that the Court which made the last guess as to the meaning of the statute says that their contracts are void and that the property owners are relieved from paying for the improvements.

There is no redress for the contractor; he loses, although he has done his work in good faith and on the advice of some attorney who professed to know what the Vrooman Act and its amendments meant.

Bonds that are supposed to be a first lien on the property are issued to the contractor, who sells them, if he can, usually at a discount of from 5 to 10% when their rate of interest is less than 8%.

Legislatures have in a great many instances, in effect set aside the Vrooman Act in a number of cities which have what is known as 'Special' charters. Under these special charters they make their own paving laws, or attempt to adapt provisions of their special charters to portions of the statutes, the result being that a number of the cities are practically prohibited from performing any general street improvements.

Another peculiar thing that exists in this State and practically has no counterpart in the United States is that any street improvement, no matter what its character, can be accepted by the city government for a period of years, and when this acceptance is passed, the property owners are relieved from any further expense, cannot be compelled to re-pave, repair, or in any manner be put to expense for the street so accepted.

To illustrate what this provision can do: One of the principal cities a few years ago graveled nearly all of its streets and they were accepted for 25 years. The courts have held that no expense can be placed upon the property owners for re-paving these streets, and the result is that the streets of this city are in a very bad condition and must remain so until 25 years have elapsed. Like conditions exist in many other cities, and necessary work such as repairing or repaving the streets, which is properly chargeable to the abutting owners, cannot be done in such California cities as have special charters.

Despite these conditions, there have been millions of square yards of pavement built in the past few years, and a résumé of these improvements may be of interest.

In the smaller cities of the State, storm drainage is the exception, and practically 90% of the cities contract for only surface drainage. While this is a subject for adverse criticism, it is a condition that materially assists in the promotion of pavements.

Experience of many years in the construction of pavements in the territory east of the Rockies would show that the necessary storm drainage costs about 33% of the total cost of street improvements. Using several million dollars of contracts as a basis, the cost of storm drainage averaged practically $1 per sq. yd. for the pavements completed. The average rainfall in this State is about 12 in. for the inhabited portions, and because of this, the smaller cities save the expense of storm drainage.

As an example of paving conditions in the smaller cities, the record of Portersville is here given, as it is typical of the general conditions.

About five years ago paving contractors directed their attention to Portersville. At that time it was a good foothill town having a population of about 2000. Several hundred thousand square feet of asphalt con-

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crete pavements was laid, the prices ranging from 23c. per foot for a 7-in. pavement built in two courses, to 18c. per foot for 5-in. asphaltic concrete. The bituminous mixture was composed of bank run gravel ranging from 3½ in. down and included a sand content of about 55%. From 5 to 8% of asphaltic cement was used to bind these materials. The 7-in. pavement has given fair satisfaction, but the 5-in. pavement has not. As a result a new paving program was inaugurated in Portersville. At the last city election held in 1914, a new board of trustees was selected and a number of public improvements were planned. Members of this board began a systematic investigation of paving, and finally, under the advice of their city engineer, Irwin Althouse, they abandoned the types of pavements previously laid in their city and adopted as a standard pavement a 5-in. hydraulic cement concrete base with an asphaltic concrete wearing surface 1½ in. thick. The specifications were the result of careful investigation and the work that has been performed under them has created much favorable comment. A great many city officials of other cities have visited the work during its construction, apparently being interested in the methods pursued. As soon as the type of paving was decided upon in Portersville, the board of trustees passed Resolutions of Intention for the construction of about thirty-two blocks of street paving and five alleys. Numerous property owners protested, under the law, against the improvements, but the protests were unanimously rejected and bids were advertised under the plans and specifications adopted.

At the time of the bidding, twelve contractors were present and ten submitted bids for the work. The following is a list of the bidders and their figures on grading and paving. The grading was an average cut of 9 inches. The streets were typical of California, in that they were petrolithic, having been oiled repeatedly. The bid on the grading is by the cubic yard and the paving per square foot. The following is a tabulation of the bids:

	Grading, cu. yd., cents.	Paving, sq. ft., cents.
Federal Construction Co., San Francisco	..	12.83
Sunset Paving Co., Visalia	58	11.50
A. C. Root Co., San Francisco	20	13.00
Thompson Bros., Fresno	47	12.30
Worswick St. Paving Co., Fresno	75	12.25
Clark & Henery Constr. Co., Stockton	1	13.80
Ransome-Crummey Co., Oakland	..	14.30
McGillivray Co., Sacramento	1	14.20
Teichert & Sons, Sacramento	50	14.30
Blanchard Brown Co., San Francisco	50	14.50

The successful bidder, the Federal Construction Co. of San Francisco, was awarded the contract at their bid of 12.83c., which included the grading. Several hundred feet of new curb was bid upon, which affected the bids. There was less than $6000 difference in the bids of all the companies, and a few cents difference on some of the streets between the successful contractor and the next bidder.

The material and labor conditions at Portersville will be a matter of interest to engineers, and the following are the prices used by most of the contractors in estimating their costs:

Refined asphalt in barrels	$11.50	per ton
Refined asphalt in tank cars	8.50	" "
200-mesh limestone dust	5.25	" "
Sand, f.o.b. cars Portersville	0.70	" "
Crushed rock, f.o.b. cars Portersville	0.85	" "
Team, including driver	5.50	" day, 9 hours
Common labor	2.75	" " " "
Portland cement, per barrel	2.41	net

The average haul for base materials was about 1½ miles, and for asphalt concrete wearing surface about 2 miles.

The price at which this contract was awarded was much less than was expected. A great many of the citizens who had protested were so fully satisfied that in many instances they signed petitions for other streets in which they were interested, and at nearly every meeting of the City Council, practically unanimous petitions were presented for street work. It was agreed between the contractor and the Superintendent of Streets that bids for additional work under similar conditions and the same specifications would be the same. The result has been that nearly 90 blocks of streets have been improved or contracted for at this time and the end is not yet. Portersville is today one of the best paved cities in California, and for its population, estimated at about 3500, it ranks far in advance in the amount of street improvements for cities of its class. A new spirit of civic betterment has taken possession of the city and the culture clubs formed by the ladies of the city are all active in seeing that the streets within the curb lines are improved, and as a result Portersville is one of the most beautiful little cities in California.

Streets paved with 5 in. of hydraulic cement concrete for a base and 1½ in. of asphaltic concrete wearing surface at a cost to the property owner of approximately $1.20 per sq. yd., puts pavement at a premium over dirt streets. The citizens of Portersville believe it is cheaper and better so to pave their streets than to suffer from the unsanitary conditions under which they lived before the present improvements were started. In Portersville the bonds issued against the property bear interest at the rate of 8%. The result has been that a large proportion of the property owners paid cash for their improvements, and one of the principal reasons why the bids were so low was because of the rate of interest, the contractor being practically sure of a cash job.

Until about five years ago the usual pavement in the smaller cities of California was an asphaltic concrete mixture, 4, 5, and in some cases 7 in. thick, but in the past four years nearly every city in the State has abandoned this type of construction and the general rule now is for hydraulic cement base with either a sheet asphalt or asphaltic concrete wearing surface.

Under the rules adopted by the State Highway Com-

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mission, all of the cities touched by the State Highway are required to build pavements passing through the city limits connecting the sections of the State Highway. Quite a number of the incorporated towns and cities are now preparing plans and specifications for necessary pavements that they will have to construct under this rule of the State Highway Commission. In most instances the plans that are proposed call for a hydraulic cement concrete base with sheet asphalt or asphaltic concrete wearing surface, though in some instances the class of construction adopted by the State Highway Commission as the general standard for their road construction will be used by these smaller incorporated cities. The trunk road built by the State Highway Commission has a 4-in. hydraulic cement concrete base with an asphalt and screening wearing surface resembling the 'Dolarway' specifications. This is true of all the improved roadways 15 ft. wide. Wherever the State Highway Commission builds a roadway of greater width than this they have adopted a 5-in. hydraulic cement concrete base with a 1½ asphaltic concrete wearing surface, this specification being used where traffic conditions are very heavy, the usual width of the road being 20 feet.

In the southern portion of the State a number of the smaller cities have made extensive street improvements of varied types of construction. The specifications adopted are modifications of the many types of pavements that have been tried in Los Angeles. The cities of Fresno, Stockton, Sacramento, San Jose, San Diego, and Pasadena present a number of peculiar paving specifications. Fresno has abandoned its asphaltic concrete base construction and in the past 3 years has laid several miles of hydraulic cement concrete base pavement with a binder course and sheet asphalt wearing surface. It contemplates a large amount of paving during the coming year.

San Jose, one of the most beautiful cities in the State, has its troubles through charter provisions, accepted streets, and the further fact that some attorneys make a business of finding technicalities in the street proceedings and harass the city government before the contracts are let, and the contractors after the contracts are let. Its streets are in very bad condition and its municipal officials seemingly cannot cope with the situation.

Sacramento, about three years ago, changed its general plan of street improvement from an asphaltic concrete base to a hydraulic cement concrete base, and several miles of streets have been contracted and are now being improved under the new specifications, which in addition to the hydraulic concrete base call for an asphaltic concrete wearing surface. Many fine examples of this character of work can be seen in the capital city.

Oakland is probably the only city in the State that still constructs oil macadam streets in the residence districts, though the general specifications for permanent streets have been hydraulic cement concrete base with a binder course and sheet asphalt wearing surface.

Pasadena has a number of specifications and has completed several large contracts during the past year, many of which are sheet asphalt on a hydraulic concrete base.

Los Angeles has as many types of pavements as paving promoters can dream of. Work is initiated by petitions and there are a great many different specifications. Work which is initiated by the city officers, as a general rule, is of the standard sheet asphalt type with a hydraulic cement concrete base from 6 to 10 in. thick, a binder course, and a sheet asphalt wearing surface.

San Francisco operates under a special charter and a very large proportion of its work is done through the Board of Public Works, although some contracts are awarded at public bidding and a great many streets have been improved by private contracts. The accepted general plan for pavement is standard sheet asphalt on concrete base, although the Board of Public Works in the past year has built some streets with hydraulic cement concrete base and paving brick wearing surface, mainly on steep grades.

In no city of the State is there so much of what is termed 'private contracts' as in San Francisco. Under the peculiar laws of the State in connection with the charter, contractors secure contracts from individual property owners for the improvement of portions of streets and proceed with the improvements, collecting from the property owners direct. The work is supposed to be done under the inspection of the city officials, and a great many streets in San Francisco will be found to be paved in part only. In cases where the property owners refuse to contract, that portion of the street which they should pay for has been left in its original condition, giving the street a checker-board appearance.

Street improvements are cheaper in California because of the avoidance of storm sewers and because rock, sand, and asphalt are generally produced at low first costs. The work completed is as good as that of any part of the country, and a large amount of paving is yet to be done.

The fine coating of lime forming on turbine blades is sometimes caused by impure water. Lime, magnesia, and graphite carried over with steam from water used in the boilers at Leavenworth, Kansas, formed an objectionable coating on the blades of the turbine, making it quite a task to keep the machine clean. Since it has been found that kerosene injected into the steam-line will clean the blades, the turbine gives no more trouble. At a convenient spot in the steam-line between the throttle and the valve rigging a small hand-pressure pump has been placed through which kerosene may be injected. Entering thus with the live steam, the oil particles are driven against all blades, and only an occasional injection from the pump is needed to keep the blades bright and clean.—*Mechanical World.*

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Road and Street Improvements on the Pacific Coast

Following is a summary of reports received from a representative body of county and city officials on all parts of the Pacific coast.

WASHINGTON

ADAMS COUNTY. There is 23 miles of improved highway, including six miles of oil macadam, and 17 miles of gravel road. Nine and one-half miles of gravel road has been constructed since January 1. O. J. Despain, Ritzville, is county engineer.

BENTON COUNTY. There is now 25 miles of improved highway in the county, nearly all water-bound macadam. Since January 1, 6.7 miles has been constructed having an oiled surface. The State expects to construct 12 miles of the Inland Empire highway, and the county to gravel 10 miles of road. T. J. Wright, Prosser, is county engineer.

CLARKE COUNTY. There is 50 miles of improved highway including two miles of warrenite, three miles of two-course concrete, one mile of tarvia, and the remainder macadam. Ten miles of macadam has been constructed since January 1. The county is now building four miles of macadam highway, and the State is building 7½ miles of macadamized road as part of the Pacific highway. The construction of 15 miles of macadam roads is proposed. W. A. Schwarz is county engineer.

DOUGLAS COUNTY. There is 29 miles of improved highway, all of gravel and crushed rock macadam. Three and eight-tenths miles has been completed since January 1, at a cost of $30,000. Five miles of gravel road is now under construction, and contract for 2¾ miles more has been awarded. Robert F. Foster, Waterville, is county engineer.

FERRY COUNTY. There is 10 miles of macadam road, three of which has been constructed since January 1. B. N. Sharp, Republic, is county engineer.

KITTITAS COUNTY. There is 40 miles of improved highway in the county, nearly all of cement gravel, rolled in two courses, and nine inches thick after being rolled. Three miles of this gravel road has been constructed since January 1, and also 2½ miles of warrenite, 2½ in. thick and 16 ft. wide with 4-ft. shoulders. Nine and one-half miles of gravel road is now under construction, and 12 miles more is proposed. Moses M. Emerson, Ellensburg, is county engineer.

LINCOLN COUNTY. There is 29 miles of improved highway in the county, including ½ mile of concrete, 13 miles of macadam, and 15½ miles of gravel macadam. Guy C. Harvey, Davenport, is county engineer.

LEWIS COUNTY. Thirteen miles of permanent highway has been constructed, 12½ miles being paved with concrete and ½ mile with warrenite. Since January 1, 1½ miles of one-course concrete pavement, 8 ft. wide, and two miles of two-course pavement, 16 and 18 ft. wide have been constructed. One and one-half miles of two-course concrete pavement, 16 ft. wide is under construction. It is expected that additional concrete pavement will be laid next year. J. D. Neville, Chehalis, is county engineer.

OKANOGAN COUNTY. There is approximately 45 miles of improved highway, mainly gravel and rock macadam. Construction work costing $59,000 is being done, under a State appropriation. Contracts have been awarded for eight miles more.

PACIFIC COUNTY. There is about forty miles of permanent highway in the county, of which one mile is of concrete and the remainder water-bound rock-macadam. Three miles of macadam has been constructed since January 1 and seven miles is now under construction. There is in addition, a $72,000 appropriation by the state legislature for a highway from Nema to Ocean Park. Charles B. Nims, South Bend, is county engineer.

PIERCE COUNTY. There is now 44.077 miles of permanent highway, of which 8.009 miles is surfaced with granitoid, 8.47 miles with asphalt, 19.854 miles with concrete, 0.744 miles with brick, 5 miles with macadam, and two miles with bitulithic. Two miles of bitulithic pavement has been constructed since January 1. No highway work is now under way, but work will soon be started on resurfacing 3.76 miles of macadam at Buckley, also 5.34 miles of road from Alderton to Orting, and 5.60 miles of Pacific highway. The type of surface to be used on these two roads has not yet been determined. David H. White, Tacoma, is county engineer.

SKAGIT COUNTY. There is 10.75 miles of permanent highway, including 0.75 mile of dolarway, three miles of macadam, one mile of gravel, and six miles of concrete. Two and one-quarter miles of the above concrete highway is now under construction. The construction of ¼ mile of concrete highway is proposed. A. L. Strong, Mt. Vernon, is county engineer.

SKAMANIA COUNTY. There is 120 miles of improved road and 21 miles of gravel road. One mile of gravel road has been constructed since January 1, and 2000 ft. more is now under construction. Bonds for $210,000 have been voted recently for construction of a 50-mile highway along Columbia river. The average cost of earth excavation is 25c., rock excavation, 80c., clearing, $70 per acre, and gravel, $1.64 per cu. yd. H. Bueches, is county engineer.

SNOHOMISH COUNTY. There is 33.75 miles of permanent highway, including one mile of brick, 3.55 miles of concrete, and 29.2 miles of gravel road. Since January 1, 16.4 miles has been constructed. About twenty miles of earth and gravel roads not classed as permanent highways are now under construction. A. B. Dean, Everett, is chief deputy county engineer.

SPOKANE COUNTY. There is 149½ miles of improved highway, including 1½ miles of warrenite, 2 miles sheet asphalt, 32 miles asphaltic macadam, 47 miles gravel macadam, and 67 miles water-bound macadam. Eleven and one-half miles of warrenite pavement, 8 ft. wide with 4-ft. asphaltic macadam shoulders, costing $165,000, and four miles of asphaltic concrete on macadam base, costing $39,056, is now under construction. Twenty miles of permanent highway will probably be constructed in 1916. State is now building 39 miles of Inland Empire highway in county, with permanent bridges and drainage, and gravel base. The warrenite pavement under construction has a 4-in. base and 2-in. wearing surface, and the asphaltic concrete has a 4½-in. base and 1½-in. wearing surface. J. W. Strack, is county engineer.

STEVENS COUNTY. There is 14 miles of permanent highway, including seven miles of gravel-surfaced road and seven of rock-surfaced. The total cost was $1104.62 for bridges and culverts, $239.76 for pipe drains, and $46,744.41 for grading, surfacing, etc. There is also 20 miles of secondary state road with earth surface, costing $460 for bridges and culverts, $1433.16 for pipe drains, and $44,843.52 for grading, etc. R. B. Thomas, Colville, is county engineer.

WALLA WALLA COUNTY. There is 27 miles of permanent highway in the county, including 21 miles of water-bound macadam, two miles oil macadam, and four miles of gravel road. There is 14 miles of gravel road not classed as permanent. Six and one-quarter miles of water-bound macadam highway is now under construction. The oiling of all macadam

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roads is under consideration, as well as the construction of two miles of gravel road. G. C. Cookerly, Walla Walla, is county engineer.

WHITMAN COUNTY. There is 33.5 miles of permanent highway, including 18 miles of bituminous macadam, and 15.5 miles of water-bound macadam. Four miles of permanent highway has been graded since January 1, and 11.3 miles is being graded, and will be surfaced next year. J. M. McCaw is county engineer.

YAKIMA COUNTY. There is 150¾ miles of improved highway, including 126⅛ miles of gravel, 9¼ miles of water-bound macadam, and 15⅜ miles of asphalt macadam. Thirteen and three-quarters miles of gravel road has been constructed since January. Two miles of water-bound macadam is now under construction. The grading of 11½ miles of road and graveling 5⅛ miles is proposed. O. E. Brashears, North Yakima, is county engineer.

ANACORTES. There is three miles of permanent street pavement, including 1½ miles of 52-ft. pavement and 1½ miles of 18-ft. pavement. The 52-ft. pavement was constructed in 1914, and is composed of 6-in. concrete base, 1-in. binder and 2-in. top. The 18-ft. pavement is constructed in the same way, except that it has a 5-in. base. It has just been completed. Another half-mile of 18-ft. pavement will be constructed this year. W. S. Clark is city engineer.

CENTRALIA. There is 4.5 miles of permanent street pavement, including 1.6 miles of vitrified brick, 0.8 mile bitulithic, 0.8 mile dolarway, 1.2 miles concrete, and 0.1 mile wood block. No more work is to be done this year, but some concrete pavement will probably be laid next year. The average cost of the brick pavement was $3 per sq. yd., of the bitulithic $2.19, of the dolarway $1.15, of the 5-in. concrete $0.81, and of the wood block $2.75. C. W. Anderson is city engineer.

ELLENSBURG. There is 3.35 miles of permanent pavement, including 2.96 miles of asphalt, 0.33 mile of brick, and 0.06 mile of dolarway. F. M. Carter is city engineer.

NORTH YAKIMA. There is 9.66 miles of permanent pavement, including 2.23 miles of brick, 2.17 miles of asphalt, 2.51 miles of bitulithic, 1.43 miles of bituminous concrete, and 1.32 miles of concrete. Since January 1, 0.55 miles of new pavement has been constructed. N. A. Gilman is city engineer.

OLYMPIA. There is 5.27 miles of permanent street pavement, including 0.12 mile of concrete, 1.31 miles of brick, 0.40 mile of wood block, 3.11 miles of sheet asphalt, and 0.33 mile of bitulithic. There is now under construction, 28,320 sq. yd. of sheet asphalt, and 11,213 sq. yd. asphaltic concrete. Ray Wood is assistant city engineer.

PORT TOWNSEND. There are no paved streets. A street is now being opened at a cost of $15,000, by cutting through a steep bluff, but there is no other street work in prospect. W. J. Stadler is city engineer.

SPOKANE. There is 66.03 miles of permanent pavement, including 33.48 miles of asphalt, 9.27 miles of brick, 5.25 miles of concrete, 2.80 miles of hassam, 0.50 mile of spokane bituminous No. 1, 3.94 miles of spokane bituminous No. 2, 4.19 miles of bitu-mass, 3.05 miles of asphaltic macadam, 2.59 miles of oileroid, 0.76 mile of wood block, and 0.20 mile of petrolithic. Morton Macartney is city engineer.

VANCOUVER. There is 11 miles of permanent street pavement, including 1½ miles of sheet asphalt, 1 mile of gravel bitulithic, 2 miles of tarvia macadam, 2 miles of one-course concrete, and 4½ miles of standard bitulithic. The construction of 2100 sq. yd. of pavement is proposed. B. L. Dorman is city engineer.

WENATCHEE. There is 1½ miles of permanent street pavement, including ¾ mile of creosoted wood blocks, ¼ mile of vitrified brick, and ½ mile asphalt macadam. F. J. Sharkey is city engineer.

WALLA WALLA. Sheet asphalt pavement was laid in 1904, 1909, and 1910, composed of 4-in. base, 1-in. binder, and 2-in. top. The cost was $2.50 per sq. yd. in 1904 and $2.05 in 1909 and 1910. The total amount laid was 148,839 sq. yd., or 29,846 lin. ft., or 5.65 miles. Standard bitulithic pavement composed of a 4-in. crushed rock base and 2-in. top, was laid in 1905 and 1906 at a cost of $2.17 per sq. yd. The total amount laid was 64,819 sq. yd., or 11,814 lin. ft., or 2.25 miles. Concrete pavement composed of a 5-in. base and 1-in. wearing surface was laid in alleys at a cost of $1.24 per sq. yd.; 7588 sq. yd. or 4572 lin. ft., or 0.87 mile was laid. Gravel bitulithic pavement composed of a 2½-in. bituminous concrete base, and 1½-in. top, was laid in 1914 and 1915 at a cost of $1.42 per sq. yd. The total amount laid was 31,153 sq. yd. or 9420 lin. ft., or 1.78 miles. Asphaltic concrete pavement is now being laid, including 10,600 sq. yd. with 3-in. bituminous concrete base and 1½-in. top, costing $0.98 per sq. yd., and 14,000 sq. yd. with 4-in. crushed rock base, and 2-in. top, costing $0.92 per sq. yd. Total mileage constructed or under construction, 12.42. It is proposed to pave 20,300 sq. yd. additional. W. R. Rehorn is city engineer.

OREGON

MULTNOMAH COUNTY. Forty miles of Columbia highway has been completed. Bonds for $1,250,000 were voted recently for the construction of 70 miles of hard-surfaced roads and work on the entire system is now under way. John B. Yeon is roadmaster.

WASCO COUNTY. There is 40 miles of improved highway, including 15 miles of bitulithic, and 25 miles of macadam. Six miles of road is now under construction, the contract price being $15,611. The construction of 45 miles of Columbia River highway is proposed. This will be a State road, but a large part of the cost is to be borne by the county. R. T. Campbell, The Dalles, is county engineer, and E. D. Sharp is roadmaster.

BAKER. There is six miles of permanent street pavement, all bitulithic. A. Finley is commissioner of streets.

CORVALLIS. There is 6½ miles of permanent street pavement, including 0.4 mile of concrete, 4.3 miles of asphalt, and 1.8 miles of bitulithic. There is now under construction 0.1 mile of concrete pavement, and 0.1 mile more is proposed. Fred J. Porter is city engineer.

EUGENE. There is 15.4 miles of permanent street pavement, of which 3.81 miles is gravel bitulithic, 7.09 miles standard bitulithic, 2.93 miles asphaltic concrete, 1.38 miles sheet asphalt, and 0.14 mile 'bitucrete.' The average cost of the gravel bitulithic was $1.65 sq. yd., of the standard bitulithic $1.80, of the asphaltic concrete $1.55, of the sheet asphalt $1.55, and of the 'bitucrete' $1.30. Since January 1, 2745 lin. ft. of sheet asphalt pavement on 5-in. concrete base has been completed at a cost of $25,080. There is now under construction 400 lin. ft. of asphaltic concrete pavement on 5-in. concrete base, costing $3219, and 4500 lin. ft. of standard bitulithic pavement on 5-in. concrete base, costing $32,916. H. D. Farneri is city engineer.

KLAMATH FALLS. There is 3.5 miles of permanent street pavement, including 2.6 miles of bitulithic and 0.9 mile of oil macadam. D. J. Zumwalt is city engineer.

MEDFORD. There is 20 miles of permanent street pavement, including 2.33 miles of bitulithic, 17.45 miles of asphalt, and 0.22 mile of concrete. O. Urnspiger is city engineer.

MARSHFIELD. There is five miles of permanent street pavement, including one mile bitulithic, 3⅜ miles bituminous rock, and ⅛ mile cedar blocks, all on concrete base. One-half mile of bituminous rock pavement is under construction. A. B. Gidley is city engineer.

OREGON CITY. There is 11½ miles of improved street, including 11 miles of macadam and ½ mile of asphaltic concrete. One-half mile of macadam and one-half mile of asphaltic concrete is under construction. C. A. Miller is city engineer.

PORTLAND. There is 359.84 miles of hard-surfaced street, including 107.89 miles of asphalt, 12.12 miles of asphaltic concrete, 4.45 miles asphaltic concrete redress, 110.81 miles bitulithic, 5.49 miles bitulithic redress, 0.15 mile bituminous mac-

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adam, 22.56 miles concrete, 0.37 mile granitoid, 35.91 miles gravel bitulithic, 46.93 miles hassam, 9.16 miles stone blocks, 0.70 mile vitrified brick, 2.29 miles wood blocks, and one mile westrumite. In addition, there is 0.54 mile elevated roadway, 264.80 miles graded earth, 83.19 miles gravel, 47.01 miles macadam, 0.80 mile plank roadway, 0.16 mile reinforced concrete bridge, 0.37 mile steel bridge, a total of 396.87 miles. Since December 1, 1914, 296 lin. ft. of asphaltic concrete on bituminous base has been constructed at a cost of $1414.95, 2960 lin. ft. of asphaltic concrete base, costing $21,637.39, 13,000 lin. ft. of bitulithic, costing $20,299.81, 960 lin. ft. bitulithic redress, costing $15,907.62, 2370 lin. ft. concrete, costing $20,432.51, 3970 lin. ft. gravel bitulithic costing $27,995.32, 550 lin. ft., hassam pavement, costing $2576.31, 5165 lin. ft. macadam, costing $21,630.84. The construction of the following pavement is proposed; 0.32 mile of asphalt, 3.42 miles of asphaltic concrete on crushed rock base, 4.75 miles asphaltic concrete on bituminous base, 0.25 mile bitulithic, 0.47 mile bitulithic redress, 0.61 mile concrete, 1.40 mile gravel bitulithic, 0.70 mile hassam, 6.58 miles macadam, 0.73 mile stone block, a total of 19.23 miles. The construction of 14.60 miles additional pavement is proposed but the type of pavement has not been determined. P. H. Dater is city engineer.

Roseburg. There is 9.5 miles of street pavement, including 6.5 miles of asphalt and three miles of concrete. Construction of two blocks of concrete pavement is proposed. L. G. Hicks is city engineer.

Salem. There is 26 miles of permanent street pavement, including 7.14 miles bitulithic, 2.83 miles asphaltic concrete, 13.25 miles concrete, 1.66 miles bituminous macadam on concrete base, and 1.10 miles asphaltic concrete on concrete base. Walter Skelton is city engineer.

CALIFORNIA

Contra Costa County. One-half mile of concrete highway has been constructed. Ten miles of concrete pavement 18 ft. wide and 5 in. thick is now under construction. Ralph R. Arnold, Martinez, is county surveyor.

Colusa. Fifteen miles of concrete-base state highway has been constructed and 29 miles more is under construction. County is constructing 58 concrete culverts and bridges, from 10 to 2800 ft. long. Forty of these have been completed and the remaining 18 are under way. J. W. Kaerth, Colusa, is county surveyor.

Eldorado County. There is 12 miles of state highway, of which 5 miles is bituminous macadam, and 7 miles is concrete with bituminous macadam wearing surface. About three miles of this highway has been constructed since January 1. The construction of 4 miles of road between Placerville and Georgetown, as well as a connecting link of the state highway between Shingle Springs and the western boundary of the county is proposed. Clifton H. Wildman is county surveyor.

Glenn County. Fourteen miles of concrete-base state highway has been completed or is now under construction. There is also 436 miles of graded and graveled road. Nine and sixtenths miles of graveled road is now under construction and work will soon start on graveling 17½ miles more. Bayard Knock, Willows, is county surveyor.

Imperial County. State highway commission is now constructing road from Dixieland to Myers canyon. C. N. Perry, El Centro, is county surveyor.

Kings County. There is no permanent highway in the county at the present time. Nine miles of concrete-base state highway is now being constructed. Work will soon be commenced on 102 miles of asphaltic macadam for the county highway system, for which a $672,500 bond issue was recently voted. Benn Duffield, Hanford, is county surveyor.

Los Angeles County. See article in this issue by F. H. Joyner, road commissioner.

Merced County. Thirty-eight miles of concrete-base state highway has been constructed. A. E. Cowell is county surveyor.

Monterey County. There is 10 miles of water-bound macadam in first-class condition and 50 miles in fair condition. Fifty-five miles of concrete-base state highway is now under construction, and the county is building 11 miles of oil macadam. Construction by the county of 11 miles of oil macadam, and 11 miles of either oil or water-bound macadam will soon be commenced. H. F. Cozzens is county surveyor.

Orange County. A county highway system of about 135 miles is being constructed, 112 miles has been completed, and work is under way on 16 miles more. This is nearly all oiled-screening surface on 4-in. concrete base. In addition there will be about 50 miles of concrete base state highway in the county, some of which is now under construction. S. H. Finley is chief engineer of highway commission.

Riverside County. A county highway system is under construction comprising 275 miles of road, of which 105 miles is to be paved with concrete and the rest surfaced with local materials. Contracts for the construction of 145 miles of road have been awarded and 30 miles of concrete pavement has been laid. George M. Pearson is chief engineer for highway commission.

San Joaquin County. See article in this issue by F. E. Quail, county surveyor.

San Luis Obispo County. There is about 40 miles of concrete-base state highway, 18 miles of which has been constructed since January 1. Contract has recently been awarded for 10 more miles of state highway. A. F. Parsons is county surveyor.

Santa Clara County. There is 60 miles of concrete-base state highway in county, and 80 miles of oil macadam. Eight miles of state highway is under construction, as well as four miles of oil macadam and 11 miles of water-bound macadam. Construction of 20 miles of road with 4-in. concrete base and 1½-in. asphaltic top is proposed. I. L. Ryder is county surveyor.

Tulare County. No permanent highways have as yet been constructed. There is about 1000 miles of oiled road. About 15 miles of concrete-base state highway is now under construction, and 10 miles of similar road has been proposed as a district improvement near Strathmore. Grading on 8 miles of mountain road is now under way. Byron Lovelace is county surveyor.

Ventura County. There is four miles of macadam road, as well as 36 miles of concrete-base state highway. Bond issue of $1,000,000 for construction of 108 miles of concrete and macadam roads is to be voted upon August 24. Charles W. Petit, Ventura, is county surveyor.

Bakersfield. There is 16.6 miles of permanent street pavement, including 11 miles of sheet asphalt, and 5.6 miles of oil macadam. One-fifth of a mile of sheet asphalt is now under construction. R. B. Ray is city engineer.

Colton. There is 1¾ miles of permanent street pavement, all sheet asphalt on concrete base. When funds have been provided, additional pavement will be laid. N. Davenport is city engineer.

East San Diego. There is 31 miles of improved street, nearly all having a decomposed granite surface. Ninety-five per cent of this work has been done during the past year. Somewhat over a mile of asphalt pavement on concrete base is being constructed, at a cost of $100,000. Other work now under way, including grading, sidewalks, and surfacing, will cost $125,000, and the expenditure of $50,000 is proposed. The average unit price for street-work is as follows: excavation, 40c. per cu. yd.; embankment, 6c. per cu. yd.; decomposed granite, $1.43 per cu. yd; corrugated culverts, from 94c. per lin. ft. for 8-in. up to $1.32 for 12-in.; part circle culverts, $2.02 per lin. ft.; curbs, 37c. per lin. ft.; sidewalks, 12.8c. per lin. ft.; concrete inlets and outlets, $3.36 each; concrete clean-outs and catchbasins, $8.62 each; 16-in. concrete pipe, $1.24

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per lin. ft.; cobblestone gutter, 7c. per sq. ft. Incidental expenses ranged from 4.12% to 15.5% of the contract cost, with an average of 8.2%. These included engineering from 2.8% to 9.29%, with an average of 5.49%; printing and advertising, from 0.36% to 2.32%, with an average of 1.01%; inspection, from 0.07% to 2.32%, with an average of 0.84%; and clerical work, from 0.16% to 3.64%, with an average of 0.89%. H. A. Kuehmsted is city engineer.

EXETER. There is about two miles of permanent pavement in city, 1750 lin. ft. of topeka, and the remainder bitulithic. The topeka pavement has been constructed since the first of the year. H. D. Watts is city engineer.

FULLERTON. There is 13 miles of permanent street pavement, all asphaltic concrete, and 2.07 miles of the Brea road is now being improved with this type of pavement. W. J. Renshaw is city engineer.

GILROY. There is 1¾ miles of asphalt pavement on concrete base. Henry B. Fisher, San Jose, is city engineer.

GRIDLEY. The construction of the first permanent pavement is now under way. Clark & Henery Construction Co., Sacramento, is the contractor. Fifteen blocks are to be paved with 1½-in. asphalt wearing surface on 4-in. concrete base. The work includes 251,778 sq. ft. of pavement, 5790 lin. ft. curbs and gutters, 3334 lin. ft. of gutters, 1448 lin. ft. of corrugated-iron arch-culverts, and 2500 cu. yd. excavation. The cost of the pavement is 18.2c. per sq. ft. It is probable that additional street work will be done in the near future. John Felleman is city engineer.

HANFORD. There is 1¼ miles of asphaltic concrete, and the construction of 3 miles more has been proposed. Max W. Enderlein is city engineer.

HAYWARD. There is 5.5 miles of asphalt pavement and 6.5 miles of macadam. The latter is being replaced by asphalt as fast as funds will permit. There is now under construction 1.1 miles of asphalt pavement, and the construction of one or two miles more, as well as several blocks of concrete pavement is proposed. J. D. Armstrong is city clerk.

HEALDSBURG. There is ½ mile of warrenite pavement. R. A. Vitousek is city clerk.

HOLLISTER. There is 2.23 miles of permanent street pavement, including 0.50 mile asphaltic concrete, and 1.73 miles of oil macadam. The asphaltic concrete cost 18.5c. per sq. ft. The oil macadam is from 6 to 8 in. thick and costs from 8¾c. to 10c., according to thickness. The construction of 0.75 mile of 4-in. concrete pavement with ½-in. wearing surface of 'durasphalt' and screenings is now under way. The cost is 11½c. per sq. ft. W. A. Winn is city engineer.

LONG BEACH. There is 45 miles of pavement, including 22 miles of sheet asphalt and 23 miles of oil macadam. Four miles of pavement is under construction, and three miles more will probably be constructed during the coming year.

LOS ANGELES. There is 2150 miles of street, of which 1083.58 miles has been improved. There is 370.58 miles of paved street, of which 277.46 miles has been accepted by the city. Up to July 1, 1914, there had been constructed, 168.49 miles of asphalt pavement, 4.555 miles of concrete, 8.185 miles of brick, 2.489 miles of bitulithic, 24.06 miles of macadam, 2.957 miles of granite blocks, 291.828 miles of oiled street, and 278.54 miles of gravel street. Since then, 52.326 miles of asphalt pavement has been constructed, 2.89 miles of concrete, 5.12 miles of brick, 4.67 miles of bitulithic, 0.116 miles of macadam, and 13.74 miles of oiled streets. Bitulithic pavement on cement-concrete base costs from 16c. for 4-in. base to 20c. for 6-in. base, the wearing surface being the same in both cases. Bitulithic pavement on bituminous concrete base costs from 14c. for 3-in. base and 1½-in. wearing surface to 15c. for 4-in. base and 2-in. wearing surface. Sheet asphalt on cement-concrete base costs from 16c. for 4-in. base, 1-in. binder, and 1½-in. wearing surface, to 18c. for 6-in. base, 1-in. binder, and 2-in. wearing surface. A sheet-asphalt pavement 1½-in. thick on a 3-in. asphaltic concrete base costs 12c. per sq. ft. Asphaltic concrete on cement-concrete base costs from 15c. for 4-in. base and 1½-in. wearing surface to 18c. for 6-in. base and 2-in. wearing surface. On a 3-in. asphaltic-concrete base, a 1½-in. asphaltic concrete wearing surface costs 12c. Cement concrete, using 1:2:3½ mixture, costs 12c. for a 5-in. pavement and 14c. for a 6-in. Where a wearing surface of a richer mixture is used, the cost is 13c. and 15c. respectively. Grading and oiling costs 2c. per sq. ft. Granite blocks on a 5-in. concrete base cost 45c. per sq. ft. On a foundation of rolled natural soil they cost 37c. per sq. ft. Vitrified brick on a 4-in. concrete base, a 1½-in. cushion, and 4-in. thick costs 28c. per sq. ft. Topeka specification pavement costs from 10c. per sq. ft. when used with a 3-in. asphaltic concrete and a 1-in. wearing surface, to 16c. when used with a 4-in. concrete base, a 1-in. binder, and a 1½-in. wearing surface. Macadam with a 4-in. broken stone base and a 2-in. wearing surface costs 11c. per sq. ft. Homer Hamlin is city engineer, and J. Alden Griffin is assistant city engineer.

MANHATTAN BEACH. There is 5½ miles of permanent street pavement, including 2 miles of warrenite, ¾ mile of bitulithic, ¾ mile of topeka top, and 2 miles of concrete with oil and screening surface. The warrenite has a 5-in. concrete base and a 2-in. surface and costs from 20.9 to 21.75c. per sq. ft. The bitulithic has a 5-in. concrete base and 2-in. wearing surface, and costs 23.1c. per sq. ft. The topeka pavement has a 5-in. concrete base and 1½-in. wearing surface. The concrete pavement is 5 in. thick and has an oil and screening surface ½ in. thick, and costs 14½c. per sq. ft. Eight more miles of this latter type of pavement is under consideration. M. M. Murray is city engineer.

MARTINEZ. There is 2¾ miles of improved streets, including 2 miles of macadam and ¾ mile of gravel street. The construction of two bridges is proposed. Elam C. Brown is city engineer.

MONROVIA. There is 27 miles of improved street, including 25 miles of oil macadam and 2 miles of petrolithic, the latter having been constructed since January 1. Ten miles of reconstructed petrolithic is under construction, and 2½ miles of new petrolithic. The construction of one mile of macadam and three miles of petrolithic is contemplated. H. S. Gierlich is city engineer.

MONTEREY. There is 11¼ miles of improved street, including ¾ mile of bituminous wearing surface on concrete base, 6 miles water-bound macadam, 4 miles granite gravel, and ½ mile oiled gravel. Two miles of water-bound macadam is now being resurfaced with 90% asphalt. The construction of ½ mile of macadam pavement with concrete curbs and gutters is proposed. The water-bound macadam is composed of clean crushed granite, 6 in. thick at the crown and 4 in. at the gutters. This costs 7c. per sq. ft. Concrete curbs and gutters cost 80c. per lin. ft. and macadam sidewalks 5c. per sq. ft. A macadam street 40 ft. wide, with 10-ft. sidewalks, making 60 ft. in all, costs $2.75 to $3 per front foot, each side of the street. Granite gravel roadway costs 3½ to 4c. per sq. ft. Bituminous pavement on concrete base costs 30c. per sq. ft. C. A. Kierman is superintendent of streets.

NAPA. There is 0.88 mile of 1½-in. bituminous pavement, on a 5-in. bituminous-rock base. J. E. Gardner is city engineer.

OAKLAND. On July 1, 1915, there was 31.936 miles of sheet asphalt pavement, 5.987 miles of rock asphalt, 1.240 miles of asphaltic concrete, 0.384 mile of asphaltic concrete base, 0.410 mile of wood block, 0.150 mile basalt block, 0.129 mile of vitrified brick, 69.168 miles of oiled macadam, 126.614 miles of water-bound macadam, 105.612 miles of water-bound macadam with oiled surface, 17.9 miles of water-bound macadam with tar surface, 43.604 miles of turnpike roads, macadamized, and 11.146 miles of turnpike roads, oiled, an increase during the fiscal year of 3.002 miles of asphalt pavement, 0.036 miles of asphaltic concrete on concrete base, 17.842 miles of oil macadam, 31.504 miles of oiled surface water-bound macadam, and 2.264 miles of oiled turnpike roads.

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There is now under construction 2.063 miles of sheet asphalt, 9000 sq. yd. of basalt block on macadam, and about 14 miles of oiled macadam. Perry F. Brown is city engineer and superintendent of streets.

OROVILLE. There is 2 miles of permanent street pavement, including 1 mile of 2-in. bitulithic on 4-in. asphaltic concrete base, and 1 mile of 1½-in. warrenite on 2½-in. asphaltic concrete base, the latter having been constructed since January 1. Another ½ mile of warrenite on asphaltic concrete is now being constructed. The bitulithic pavement cost 18.4c. per sq. ft. for pavement, 1.5c. for grading, and 0.73c. for incidentals, totaling 20.63c. per sq. ft. The warrenite pavement cost 12.9c. per sq. ft. for pavement, 1c. for grading, and 0.6c. for incidentals. Total 14.5c. per sq. ft. The asphaltic concrete was plant-mixed. S. J. Norris is city engineer.

PASADENA. During the year ending June 30, 1915, 15,209 lin. ft. of street was graded at a cost of $9515.50, 36,016 lin. ft. of curb was constructed at a cost of $9028.63, 80,510 sq. ft. of gutter was laid at a cost of $11,299.29, 113,420.20 sq. ft. of sidewalk was constructed at a cost of $9578.58, and 1418.561 sq. ft. of pavement was constructed, costing $106,286.67. Oiling cost 4c. per sq. ft., oil macadam cost 7c. for 4-in. to 8.85c. for 6-in., 4-in. concrete pavement without oil cost 8.4c., and asphalt pavement cost 18 to 19 cents. R. W. Orbison is city engineer.

PORTERSVILLE. See article on page 113 of this issue.

REDONDO BEACH. There is 24 miles of improved street, including 14 miles of oil macadam, 5 miles of warrenite, and 5 miles of sheet asphalt, both of the latter pavements being on concrete base. The construction of 14,000 lin. ft. of warrenite and asphalt pavement on concrete base is proposed. E. Jensen is superintendent of streets.

SAN BERNARDINO. There is 17 miles of permanent street, including 12 miles of oil macadam, 3 miles of asphalt, and 2 miles of concrete with an oil-screening surface. This does not include several miles of graded and oiled streets. One mile of pavement with a 4-in. concrete base and ⅜-in. oiled-screening surface is now under construction. The cost of oil macadam is 9c. per sq. ft., of asphalt on macadam base 12c., of asphalt on concrete base 17c., of concrete with screening surface 10c. J. M. Oakey is city engineer.

SAN BRUNO. Plans are being prepared and bids will soon be received for the construction of 11 miles of 4 and 5-in. concrete-base pavement with asphaltic concrete wearing surface. Eric Wold, Burlingame, is city engineer.

SAN FERNANDO. There is 5.16 miles of permanent street pavement, including 2.61 miles asphalt, 2.02 miles oil macadam, and 0.53 mile oiled and graveled. Construction of 4780 lin. ft. additional asphalt pavement is proposed. H. C. Caldwell is superintendent of streets.

SAN FRANCISCO CITY AND COUNTY. There is now 3,900,000 sq. yd. bituminous rock pavement, 1,550,000 sq. yd. asphalt, 2,260,000 sq. yd. basalt block, 249,600 sq. yd. cobblestones, 15,300 sq. yd. vitrified brick, 900,000 sq. yd. macadam, and 10,000 sq. yd. creosoted wood blocks. During the past year, the following pavement has been laid: 431,176.50 sq. yd. asphalt, at a cost of $839,609.67; 38,295.80 sq. yd. bitumen, at a cost of $88,816.97; 15,478.60 sq. yd. basalt block on concrete strip, at a cost of $58,227.38; 36,953.10 sq. yd. broken rock, at a cost of $27,607.93; 17,872.10 sq. yd. basalt block on sand, at a cost of $59,632.49; 8257.50 sq. yd. basalt block on concrete, at a cost of $31,481.59; 370.60 sq. yd. basalt header block, at a cost of $286.14; 7895.20 sq. yd. vitrified brick at a cost of $28,263.98; 2812.80 sq. yd. cobblestones, at a cost of $6476.79; 991.80 sq. yd. basalt base, at a cost of $227.36; a total of 560,104 sq. yd., at a cost of $1,140,630.30. M. M. O'Shaughnessy is city engineer.

SAN MATEO. There is 14 miles of permanent street pavement, mainly 1½ to 2-in. asphaltic wearing surface on 4-in. concrete base. A little pavement is laid on asphaltic-concrete base. A contract has just been awarded for the construction of 6 miles of 1½-in. sheet-asphalt wearing surface on a 4-in. concrete base. The cost of pavement, without grading, has ranged from 17c. per sq. yd. in 1910 down to 11½c. at present. W. C. Hammatt, Hearst building, San Francisco, is city engineer.

SANTA CLARA. There is ⅜ mile of asphalt pavement on concrete base. The construction of two miles additional of this type of pavement is proposed. Henry B. Fisher, San Jose, is town engineer.

SANTA MARIA. There is 2 miles of oil-macadam street, all of which has been completed since January 1. The construction of another mile has been proposed. R. H. Laughlin is city clerk.

SANTA MONICA. There is 44 miles of improved street, including 2.4 miles of concrete, 7.1 miles of asphalt, and 34.5 miles of water-bound and oil macadam. Since January 1, 1800 lin. ft. of sheet asphalt has been constructed, 6060 lin. ft. concrete, 3910 lin. ft. oil macadam, and 5400 lin. ft. concrete in alleys. Work now under construction includes 1669 lin. ft. sheet asphalt, and 420 lin. ft. concrete. The construction of 8378 lin. ft. of sheet asphalt and 40,065 lin. ft. of concrete is proposed. The cost of sheet asphalt with a 5-in. concrete base, 1-in. binder, and 2-in. wearing surface runs from 17¾ to 23c. per sq. ft., the latter being where a large fill requiring a retaining wall, was made. A 4-in. concrete pavement costs 10 to 12c. per sq. ft. Oil and water-bound macadam 5 in. thick costs 9 to 12c. per sq. ft. All future pavement is to be laid with a concrete base. John A. Morton is city engineer.

SAUSALITO. The first permanent street pavement is now under construction. This includes 2½ miles topeka top on 4 and 5-in. concrete base, ¼ mile on a steep grade having a 10-ft. vitrified brick strip in centre, also 1½ miles of macadam. L. L. Hohl is city engineer.

SELMA. There is 1 mile of asphaltic concrete pavement. It is proposed to pave 1 mile of West Front street. Concrete base and asphaltic top will probably be used. W. H. Shafer is city engineer.

SOUTH PASADENA. There is 6 miles of permanent street pavement, including 4.2 miles of asphaltic concrete, 5 in. thick, and 1.8 miles of sheet asphalt on concrete base. The construction of three miles of additional paving is proposed. The asphalt concrete cost from 13 to 16.6c. per sq. ft. The asphalt pavement cost 15.7c. per sq. ft. for 5-in. concrete base, 1-in. binder, and 2-in. wearing surface, and 13.7c. per sq. ft. for 4-in. concrete base and 2-in. wearing surface. John MacMillan is city engineer.

TULARE. Street improvements have been delayed by legal complications, but work will soon be started on 70 blocks of concrete-base pavement with asphaltic concrete wearing surface.

VACAVILLE. There is about 1 mile of water-bound macadam street. Expenditure of $12,000 on oil macadam is proposed. F. A. Steiger is city engineer.

VENICE. There is 28.80 miles of improved street, including 11 miles of asphalt, 6.25 miles of macadam, three miles of warrenite, 1.25 miles of brick, and 3.30 miles of concrete. The warrenite has been constructed since January 1. The construction of about a mile of warrenite and asphaltic concrete pavement is proposed. W. F. Crawford is city engineer.

VISALIA. There is 3 miles of permanent street pavement, including ¾ mile of topeka on concrete base, ¾ mile sheet asphalt on asphaltic base, and 1½ miles of asphaltic concrete. The topeka pavement has been laid during the past year. Proceedings have been started for ten blocks of pavement, and it is probable that another ten blocks will be paved. L. E. McCabe is city engineer.

WOODLAND. There is 1½ miles of permanent street pavement, including 1 mile of 1½-in. sheet asphalt wearing surface on 4-in. concrete base, and ½ mile of oil macadam with mastic surface. Construction of two miles additional is up for immediate consideration. C. E. Arnold is city engineer.

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Road Exhibits at the Panama-Pacific Exposition*

From the standpoint of the road-builder, the exhibits of the Office of Public Roads of the United States Department of Agriculture and of the California State Highway Commission are the most interesting at the Exposition. The former is situated in the Palace of Machinery, on Avenue B, between Third and Fourth streets. The exhibit is composed mainly of models of the different types of road constructed in the past and at the present time. Most of these are on a scale of one inch to the foot.

One series shows the evolution of road construction from the Roman road of antiquity down to the first-class macadam road, which was considered, until recently, the last word in road construction. The Roman method of construction was not uniform, but the roads built at that time were usually from 16 to 30 ft. wide and three to four feet thick, the road material being laid in three or four courses. Large flat stones were placed as the bottom course and each succeeding course was composed of smaller stones. In swampy country, logs or similar material were placed under the first course. The next model shows the roads constructed in France during the seventeenth and eighteenth centuries. This type was similar to the Roman roads except that the thickness of material ranged from 1½ to 2½ ft. and only three courses were used, including the wearing surface. Lack of provision for drainage in the first place and inadequate maintenance later on, interfered seriously with good results being obtained from these roads. About 1775, Tresaguet, who was probably the first road engineer to appreciate the importance of proper drainage, introduced a different method of construction. By crowning and draining the foundation he was able to reduce the thickness of the road to about ten inches, besides obtaining better results. Except that the lower course was composed of large, flat stones, the construction was similar to that of the present-day macadam road. The telford road was originally laid on a flat subgrade and only the surface crowned, but at the present time telford roads are constructed with a crowned foundation. Stones averaging 3 by 5 by 7 in. are used for the base and the interstices filled with smaller stones before the second course is placed. The principal features of the macadam road are too well known to be described here. The introduction of the road roller changed the methods of consolidating the roadbed, but otherwise the construction of water-bound macadam roads is practically the same as a century ago.

Another series of models shows the various types of road constructed at the present time. There is a cement-concrete road either with or without a bituminous surface. The topeka specification pavement is shown laid on a concrete foundation, although it is sometimes constructed on a crushed-rock base. Brick roads and asphalt block roads are usually constructed on a concrete foundation. Paved roads should be constructed with well-rolled earth shoulders. Another model shows the various stages in the construction of an earth road, as well as the improvement of an existing road by drainage, and by the use of the road-grader and road-drag. The construction of a sand-clay road by the proper mixture of the two materials is illustrated. The next model shows the method of construction of a two-course gravel road. The construction of bituminous macadam roads is illustrated by several models, the penetration and the mixing methods being both shown. Other models show the methods of road drainage, types of concrete highway-bridges, and several kinds of road machinery. There are also a number of photographs and charts pertaining to road-construction and to the work of the Office of Public Roads.

The exhibit of the California State Highway Commission is in the Palace of Liberal Arts, on Avenue D, between Seventh and Eighth streets. There is a large relief-map of the State, showing the completed highways up to February 1915, as well as the roads under construction and proposed. On the walls there are a number of photographs of highways completed and under construction, and a number of working-profiles, bridge-plans, etc. A map of the highway system shows also a number of the roads that have been improved by the local authorities. Another part of the exhibit shows samples of road materials, including crushed rock, gravel, sand, and portland cement for concrete, and screenings, sand, and road-oil for the wearing surface. Sections cut from completed highways, and which have stood the test of time are also shown. Specimens were taken at various places on the highway through the San Joaquin valley after two years' service. These were composed of a 4-in. concrete base made of a 1:2½:5 mixture with a wearing surface containing 10% California asphalt and 90% sand and screenings. Other specimens were taken from the highway between San Francisco and San Jose, which sustains an unusually heavy traffic, amounting in some cases to as many as 15,000 automobiles per day. The pavement used here had a 5 or 6-in. concrete base with a 1:3:6 mixture. Sheet asphalt or topeka specification wearing surface is used on part of this road.

There are many other exhibits in the different buildings that have to do, either directly or indirectly, with road-building. In the Palace of Mines, at 7th Avenue and C street, the Standard Oil Company's exhibit includes samples of road-oil, asphalt, and other road-building material. The Union Oil Company, immediately adjoining, has a similar exhibit with respect to road-materials.

*Staff article.

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The Oregon State Highway System

By G. ED. ROSS*

The highway department of the State of Oregon was created by the 1913 Legislature. This law provided for a commission of three members, composed of the governor as chairman, the secretary of state, and the state treasurer. This commission was to appoint a state highway engineer, who reported directly to them on all highway matters.

During the year 1914 several trunk-lines through the State were established. One, known as the Columbia highway, starts at the Oregon-Washington line south of Walla Walla, runs southwest to Pendleton via Echo, thence to the Columbia river at a point near Biggs, and thence following the Columbia river through Portland to Astoria and Seaside. Another trunk-line, the Pacific highway, starts from Portland, runs from Portland via Oregon City to Salem, thence to Albany, on the east side of the Willamette river, crossing the Willamette river at Albany, and runs south through Eugene, Roseburg, Grants Pass, Medford, and Ashland to the California line. Another proposed trunk-line starts from Wasco in Sherman county and runs almost directly south through Antelope, Prineville, and Lakeview, to the California line. This is known as the Central Oregon highway. Another line runs almost directly south from The Dalles through Redmond, La Pine, Crescent, and Klamath Falls, making a sharp turn westerly at Klamath Falls and thence to the California line. This is known as The Dalles-California line. Another trunk-line is known as the Capital highway, and starts from Portland, running parallel to the Pacific highway on the west side of the Willamette river, joining the Pacific highway at Salem, and continuing on the west side of the Willamette river as far as Albany.

Aside from these trunk-lines there are various connecting links proposed. One is to run west from Salem through Dallas and Toledo to Newport. One is to branch from the Capital highway near Tigard, and run to Hillsboro, thence westerly to Tillamook. Another is to run from Eugene, easterly through the McKenzie pass to Sisters, thence through Redmond, and will terminate at Prineville. A fourth road is to start at Millican, on the Central Oregon highway, and run first easterly and then directly south to Burns and Crowley, there making a sharp turn north and east to Vale and the Idaho line. Another road is to run from Pendleton in a southeasterly direction to La Grande, Baker, and Huntington, and reach the Idaho line at Olds Ferry. There is another line proposed from Seaside along the beach in Clatsop county and traversing the entire coast of Oregon to the California line.

Most of the construction that has been done so far has been confined to the Columbia highway, from Hood River to Seaside, and to the Pacific highway in Jackson county. A small amount of work has been done on the Columbia highway between Biggs and Wasco. In Jackson county more than $400,000 has been spent on the Pacific highway, where a large amount of concrete and asphalt paving has been done. At the present time, construction of concrete pavement is being carried on in the Siskiyou Mountain portion with the expectation of eventually paving this entire division. A movement is also on foot to submit the question of a bond issue of $10,000,000 for road purposes to the voters at the next election. It is believed by many road enthusiasts that before many years the greater part of the Pacific highway, traversing the State of Oregon from north to south, will be hard-surfaced.

The law creating the highway commission also created a road fund by providing a ¼-mill tax. This amounts to about $233,000 per annum. The law also provides that the services of the highway engineer and of the department may be loaned to counties voting bonds for road purposes, and, during the year 1914, this opportunity was utilized to such an extent that the department had about $1,700,000 worth of work within its control. The Legislature of 1915 provided that the state highway engineer, who is an elective officer, should assume the duties imposed by the former law on the state highway engineer, and that there be appointed a chief deputy state engineer to have charge of matters pertaining to the state highway department. In the short time it has been in operation, the department has made a creditable showing, and the people of Oregon are fast being educated to the point of appreciating the value of proper road construction.

*Auditor State Highway Department, Salem, Oregon.

American Builders' Week, which will be celebrated at the Panama-Pacific Exposition, October 18 to 23, seems likely to be one of the most interesting events of the Exposition year. The General Contractors' Association of San Francisco is to have charge of all arrangements. Besides the usual excursions and similar festivities which have come to be associated in the popular mind with conventions in San Francisco this year, on October 21, which has been designated Builders' Day at the Exposition, there will be a parade which will show all portions of the work of erecting a building, from the activities of the architects and financiers at its inception down to the finishing touches of construction. While the convention will open on the same day, most of the sessions will be held on October 22. All the events of the week are planned to commemorate especially the work of the builders in reconstructing San Francisco after the Fire, and in the construction of the Exposition buildings.

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Program of International Engineering Congress

September 20-25, San Francisco, California.

PROGRAM

All sessions are to be held in the Auditorium Building, Civic Center, Hayes and Larkin St. at Market Street.

GENERAL SESSIONS.

MONDAY, September 20, 10 a.m.

Opening General Session

Address of welcome by the Mayor of San Francisco.

Addresses by General Goethals, honorary president of the Congress, the honorary vice-presidents and the distinguished delegates.

Presentation of John Fritz medal to Dr. James Douglas, past-president and honorary member Am. Inst. M. E.

SATURDAY, September 25, 11:30 a.m.

Closing General Session

SECTION SESSIONS

MONDAY, September 20, 2 p.m.

The Panama Canal

(General Session)

Introductory Paper.

General G. W. Goethals, Late Chief Engineer, Isthmian Canal Commission; Governor Panama Canal Zone.

Commercial and Trade Aspects of the Panama Canal.

Emory R. Johnson, Ph.D., Sc.D., Professor of Transportation and Commerce, University of Pennsylvania; Special Commissoner on Panama Canal Traffic and Tolls, 1911-1913.

The Working Force of the Panama Canal.

Captain R. E. Wood, U. S. A., Balboa Heights, Canal Zone, Panama.

Purchase of Supplies for the Panama Canal.

F. C. Boggs, M. Am. Soc. C. E., Major Corps of Engineers, U. S. Army; General Purchasing Officer of Panama Canal, Washington D. C.

Outline of Canal Zone Geology.

Donald F. MacDonald, Geologist, U. S. Bureau of Mines, Department of the Interior, Washington, D. C.

Climatology and Hydrology of the Panama Canal.

F. D. Willson.

The other Panama Canal papers will be presented in the various sections of the Congress according to subject matter, and as listed under the various sectional programs.

TUESDAY, September 21, 10 a.m.

Waterways

(Session 1)

The Province of Waterways in the Internal Commerce and Development of a Country.

Brig. General W. H. Bixby, U. S. A., retired.

Artificial Waterways which form cut-offs on Marine Routes, and Waterways Consisting of Natural Channels and Bodies of Water Linked by Artificial Channels, Constituting Inside Routes.

C. S. Riché, M. Am. Soc. C. E., Lt. Col., Corps of Engineers, U. S. A.

The Waterway from the German Rhine Through the Netherlands to the North Sea Along the Rivers Rhine, Waal and Nieuwe Maas.

C. A. Jolles, c.i., Chief-Engineer-Director of the Government Waterstaat, Arnhem, Netherlands.

Natural Waterways in the United States.

Lt. Col. Wm. W. Harts, Corps of Engineers, U. S. A.

TUESDAY, September 21, 2 p.m.

(Session 2)

Flood Control.

H. M. Chittenden, Brig. General, U. S. A., Retired, M. Am. Soc. C. E., Seattle, Washington.

Flood Control in China.

Charles Davis Jameson, M. Am. Soc. C. E., General Adviser, Chinese River Conservancy, Washington, D. C.

Works for the Improvement of Navigable Estuaries.

Prof. Dr. Luigi Luiggi, Inspector General of Civil Engineers; Professor of Hydraulic Construction at the Royal Polytechnic of Rome, Italy.

The River Improvement Works in Japan.

Tadao Okino, Vice-Pres. Civil Engineering Society; Chief Engineer Home Department, Japan.

WEDNESDAY, September 22, 10 a.m.

(Session 3)

Dry Excavation.

General G. W. Goethals, Late Chief Engineer, Isthmian Canal Commission; Governor Panama Canal Zone.

Dredging in the Panama Canal.

W. G. Comber.

Construction of Gatun Locks, Dam and Spillway.

Brig. General W. L. Sibert, San Francisco.

Method of Construction of the Locks, Dams, and Regulating Works in the Pacific Division of the Panama Canal.

S. B. Williamson, Formerly Division Engineer, Pacific Division Panama Canal.

Lock Gates, Chain Fenders and Lock Entrance Caissons.

Henry Goldmark, M. Am. Soc. C. E., Formerly Designing Engineer, Isthmian Canal Com., Consulting Engineer, New York.

THURSDAY, September 23, 10 a.m.

(Session 4)

The General Design of the Locks, Dams, and Regulating Works of the Panama Canal.

Brig. General H. F. Hodges, U. S. A., formerly Assistant Chief Engineer, Isthmian Canal Commission.

Design of the Lock Walls and Valves of the Panama Canal.

L. D. Cornish, M. Am. Soc. C. E., former Designing Engineer for Isthmian Canal Commission, Office of Division Engineer, War Department, Cincinnati, Ohio.

The Design of the Spillways of the Panama Canal.

E. C. Sherman, M. Am. Soc. C. E., formerly Designing Engineer, Panama Canal, Consulting Engineer, Boston.

Emergency Dams Above Locks of the Panama Canal.

T. B. Mönniche, M. Am. Soc. C. E., Engineer of Docks, Panama R. R., Cristobal, Canal Zone, Panama.

Hydraulics of the Locking Operations of the Panama Canal.

R. H. Whitehead.

Irrigation

THURSDAY, September 23, 2 p.m.

(Session 5)

Irrigation Enterprise in the United States.

C. E. Grunsky, Dr. Ing. M. Am. Soc. C. E., San Francisco.

Economic Advisability of Irrigation.

F. H. Newell, U. S. Reclamation Service.

Distribution Systems, Methods, and Appliances in Irrigation.

J. S. Dennis, H. B. Muckleston, and R. S. Stockton, Calgary, Alberta, Canada.

Italian Irrigation.

Prof. Luigi Luiggi, D. Sc., M. Am. Soc. C. E., Professor of Hydraulic Engineering at the Royal University of Rome, Italy.

Irrigation in Lybia (Italian Colony).

Prof. Luigi Luiggi, D.Sc., M. Am. Soc. C. E., and President of the Italian Society of Civil Engineers, Rome, Italy.

FRIDAY, September 24, 10 a.m.

(Session 6)

Utilization of Underground Waters.

G. E. P. Smith, Irrigation Engineer, Tucson, Arizona.

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Irrigation in India.

M. Nethersole, Inspector General of Irrigation, Simla, India.

Dams.

Arthur P. Davis, M. Am. Soc. C. E., Chief Engineer, U. S. Reclamation Service, Washington, D. C.

D. C. Henny, M. Am. Soc. C. E., Consulting Engineer, Portland, Oregon.

Earthen Dams.

William Lumisden Strange, M. I. C. E., late Chief Engineer in Sind, India; Laracor Mill Road, Worthington, England.

FRIDAY, September 24, 2 p.m.

(Session 7)

The Distribution of Water in Irrigation in Australia.

Elwood Mead, M. Am. Soc. C. E., M. I. C. E., late Chairman State Rivers and Water Supply Com., Melbourne, Victoria, Australia; Berkeley, Cal.

The Co-relation between Demand and Supply, in view of the Variation between Annual Demand and Supply from Natural Flow, which leads up to a Study of the Amount of Storage Necessary.

L. C. Hill, M. Am. Soc. C. E.

Irrigation in Spain—Distribution Systems, Methods, and Appliances.

J. C. Stevens, M. Am. Soc. C. E., Portland, Oregon.

Irrigation in Spain—Regulations Controlling the Use of Water, Metering Water for Irrigation, and Methods of Charging.

J. C. Stevens, M. Am. Soc. C. E., Portland, Oregon.

SATURDAY, September 25, 10 a.m.

(Session 8)

The Problem of Irrigation in the Argentine Republic.

Carlos Wauters, Professor, University of Buenos Aires.

Duty of Water in Irrigation.

Samuel Fortier, Chief of Irrigation Investigations, Office of Experiment Stations, U. S. Dept. of Agriculture, Washington, D. C.

Drainage as a Correlative of Irrigation.

C. G. Elliott, M. Am. Soc. C. E., Washington, D. C.

Municipal Engineering

TUESDAY, September 21, 2 p.m.

City Planning.

Nelson P. Lewis, M. Am. Soc. C. E., Chief Engineer, Board of Estimate and Apportionment, New York.

London Traffic in 1913.

Sir Albert Stanley, London, England.

Transit Problems in American Cities.

W. F. Reeves, M. Am. Soc. C. E., Asst. Engr. Interborough Rapid Transit Co.

WEDNESDAY, September 22, 10 a.m.

(Session 2)

Recent Progress and Tendencies in Municipal Water Supply in the U. S.

J. W. Alvord, M. Am. Soc. C. E.

Municipal Water Supply in France, Belgium, Algeria-Tunisia.

Dr. E. Imbeaux, Engineer in Chief, Professor at l'Ecole Nationale des Ponts et Chaussées, Paris, France.

The Disposal of Suspended Matters in Sewage.

Rudolph Hering, D.Sc., M. Am. Soc. C. E., New York.

Sewage for Low Countries with Special Regard to the Town of Amsterdam.

A. W. Bos, Director of Public Works, Amsterdam; Amsterdam, The Netherlands.

THURSDAY, September 23, 10 a.m.

(Session 3)

Streets.

Geo. W. Tillson, M. Am. Soc. C. E., Consulting Engr.; Office of the President, Borough of Brooklyn, New York.

Rural Highways.

L. W. Page, Director, Office of Public Roads, U. S. Dept. of the Interior, Washington, D. C.

Rural Highways.

L. Limasset, Chief Engineer of Bridges and Highways, Paris, France.

Construction and Maintenance of Rural Highways.

Alfred Dryland, M. I. C. E., County Surveyor of Surrey, England; Member of the Advisory Engineering Committee of H. M. Road Board.

Rural Highways.

Arthur Gladwell, Mem. Inst. Municipal & County Engineers; Engineer and Surveyor, Eaton Rural District Council, England.

The Struggle Against Dust.

C. C. Dassen, Engr., Inspector General of Streets for the City of Buenos Aires.

FRIDAY, September 24, 10 a.m.

(Session 4)

Utilities.

Dr. A. C. Humphreys.

Short Paper on Public Utilities.

Edward Willis, A. M. I. C. C., F. S. I., M. R. San I., F. R. S. A., Chiswick, England.

Arch Bridges of Hooped Cast Iron.

Dr. Ing. Fritz von Emperger, Vienna, Austria.

FRIDAY, September 24, 2 p.m.

(Session 5)

Preliminary Municipal Engineering at Panama.

Henry Welles Durham, M. Am. Soc. C. E., formerly Resident Engr. in Charge of Municipal Engineering at Panama City, New York.

Municipal Engineering and Domestic Water Supply in the Canal Zone.

George M. Wells, M. Am. Soc. C. E.; Res. Engr., Division of Municipal Engrg., Panama Canal, Balboa Heights, Canal Zone, Panama.

Sanitation in the Panama Canal Zone.

Lt. Col. Chas. F. Mason, Medical Corps, U. S. A.; Chief Health Officer of the Panama Canal, Balboa Heights, Canal Zone.

'Soliditit' Concrete Roads in Italy.

Prof. Luigi Luiggi, D.Sc., M. Am. Soc. C. E., M. I. C. E.; President Italian Society of Civil Engineers, Rome, Italy.

Railway Engineering

TUESDAY, September 21, 10 a.m.

(Session 1)

Railways of the World.

Wm. Barclay Parsons, M. Am. Soc. C. E., Consulting Engineer, New York.

The Status of the Railways of North and South America.

F. Lavis, M. Am. Soc. C. E., Consulting Engineer, New York.

Italian Railways.

Prof. Luigi Luiggi, D.Sc., M. Am. Soc. C. E.; President Italian Society of Civil Engineers; former Member of the Italian State Railway Board, Rome, Italy.

The Status of Indian Railways.

Victor Bayley, Assoc. M. I. C. E., Asst. Sec. Railway Board, India, Simla, India.

The Status of Chinese Railways.

Charles Davis Jameson, M. Am. Soc. C. E., Supervising Engr. and Archt. to the Imperial Chinese Board of Foreign Affairs (Wai Wu Pu), Pekin, China.

The Status of Russian Railways.

V. A. Nagrodsky, Petrograd, Russia.

The Status of Railways and Tramways in the Netherlands East-Indies.

E. P. Wellenstein, C. E., Netherland Indian Government Railway's Engineer; lately Batavia; at present, The Hague.

TUESDAY, September 21, 2 p.m.

(Session 2)

Economic Considerations Controlling and Governing the Building of New Lines.

John F. Stevens, M. Am. Soc. C. E., New York.

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The Locating of a New Line.

William Hood, Chief Engineer, Southern Pacific Co., San Francisco.

The Reconstruction of the Panama Railroad.

Frederick Mears, M. Am. Soc. C. E., formerly Chief Engineer, Panama R. R.; Member Alaska Engineering Commission, Washington, D. C.

The Locating of a New Line.

David Wilson, B.A., Assoc. M. I. C. E., Johannesburg, South Africa.

Railway Construction Methods and Equipment in Australia.

Maurice E. Kernot, M. I. C. E., M. Am. Soc. C. E.; Chief Engineer for Railway Construction, Victoria, Australia; Berkeley, Cal.

THURSDAY, September 23, 10 a.m.

(Session 3)

American Railroad Bridges.

J. E. Greiner, M. Am. Soc. C. E., Baltimore, Md.

Tunnels.

Charles S. Churchill, M. Am. Soc. C. E., Roanoke, Va.

Tunnels in Italy.

Prof. Luigi Luiggi, D.Sc., M. Am. Soc. C. E.; President Italian Society of Civil Engrs.; former Member of the Italian State Railway Board, Rome, Italy.

Tunnels in Switzerland.

R. Winkler, Direktor der technischen Abteilung der Schweizer Eisenbahndepartements, Berne, Switzerland.

Track and Roadbed.

George H. Pegram, M. Am. Soc. C. E., Chief Engineer, Interborough Rapid Transit Co., New York.

THURSDAY, September 23, 2 p.m.

(Session 4)

Recent Locomotive Development.

George R. Henderson, Consulting Engineer of the Baldwin Locomotive Works, Philadelphia, Pa.

Rolling Stock (other than Motive Power)

A. Stucki, M. Am. Soc. M. E., President, Engineers' Society of Western Pennsylvania, Pittsburg, Pa.

The Floating Equipment of a Railroad.

F. L. DuBosque, M. S. N. A. & M. E., New York.

Railroad Terminals.

B. F. Cresson, Jr., New Jersey Harbor Com., Jersey City, N. J.

FRIDAY, September 24, 10 a.m.

(Session 5)

Electric Motive Power in the Operation of Railroads.

William Hood, San Francisco.

Electric Motive Power in the Operation of Railroads.

E. H. McHenry, M. Am. Soc. C. E., M. Can. Soc. C. E., New Haven, Conn.

Signals and Interlocking.

Charles Hansel, M. Am. Soc. C. E., New York.

Materials of Engineering Construction

TUESDAY, September 21, 10 a.m.

(Session 1)

Structural Timber in the United States.

H. S. Betts, Engineer in Forest Products, Forest Products Laboratory, U. S. Forest Service, Madison, Wis.
W. B. Greeley, Assistant Forester, U. S. Forest Service, Washington, D. C.

Timber in Canada.

R. H. Campbell, Forestry Dept., Ottawa, Canada.

Indian Timbers Used in Engineering Construction.

R. S. Pearson, I. F. S., F. L. S., Forest Economist, Forest Research Institute, Dehra Dun, India.

Timber in Russia.

Mr. Tkachenko, Imperial Forest Inst., Petrograd, Russia.

Preservative Treatment of Timber.

Howard F. Weiss, Director, Forest Products Laboratory.
Clyde H. Teesdale, in charge of Wood Preservation, Forest Products Laboratory, Madison, Wis.

TUESDAY, September 21, 2 p.m.

(Session 2)

Clay Products as an Engineering Material.

A. V. Bleininger, Bureau of Standards, U. S. Dept. of Commerce, Pittsburg, Pa.

Aggregates for Concrete.

S. E. Thompson, M. Am. Soc. C. E., M. Am. Soc. M. E., Newton Highlands, Mass.

Probable and Presumptive Life of Concrete Structure Made from Modern Cements.

Bertram Blount, London, England.

Volume Changes in Concrete.

Alfred H. White, Professor of Chemical Engrg. at the University of Michigan, Ann Arbor, Mich.

Use of Wood in Concrete in Structures Standing in Sea Water with Special Reference to Dock Work.

Harrison S. Taft, Esq., Consulting Engineer, Seattle, Wash.

WEDNESDAY, September 22, 10 a.m.

(Session 3)

The Outlook for Iron.

James Furman Kemp, Professor of Geology, Columbia University, New York.

Alloy Steels in Bridgework.

J. A. L. Waddell, D.Sc., D.E., LL.D., M. Am. Soc. C. E., Consulting Engineer, Kansas City, Mo.

THURSDAY, September 23, 10 a.m.

(Session 4)

The Economics of the World's Supply of Copper.

Thomas T. Read, M. A. I. M. E., San Francisco.

Consumption of Copper and its Various Uses.

Thomas T. Read, M. A. I. M. E., San Francisco.
H. D. Hawks.

Alloys and their Use in Engineering Construction.

W. Reuben Webster, M. Am. Soc. M. E., Bridgeport, Conn.

The Engineering Uses of Aluminum.

Jos. W. Richards, Professor of Metallurgy, Lehigh University, South Bethlehem, Pa.

THURSDAY, September 23, 2 p.m.

(Session 5)

Testing of Materials.

R. G. Batson, Asso. M. I. C. E.; Associate of King's College, London; Assist. in the Engrg. Dept. of the Nat'l Physical Laboratory, Teddington, England.

Testing Full Size Members.

Gaetano Lanza, Philadelphia, Pa.

Proof Testing of Structures.

J. E. Howard, Interstate Commerce Commission, Washington, D. C.

Mechanical Engineering

TUESDAY, September 21, 10 a.m.

(Session 1)

Recent Advances and Improvements in Founding.

Thomas D. West (deceased), M. Am. Soc. M. E., Cleveland, Ohio.

Forgings from Early Times Until the Present.

C. von Philip, M. Am. Soc. M. E., South Bethlehem, Pa.

Recent Progress and Present Status of the Art of Forging with Special Reference to the Use of Quick-Acting Forging Presses.

A. J. Capron, M. I. C. E., Sheffield, England.

Permanent Shops, Pacific Terminals—Panama Canal.

H. D. Hinman, Asso. M. Am. Soc. C. E.
A. L. Bell, Asso. M. Am. Soc. M. E.

TUESDAY, September 21, 2 p.m.

(Session 2)

Machine Shop Equipment, Methods, and Processes.

E. R. Norris, Dir. of Mfg. Operations, Westinghouse Elect. & Mfg. Co., East Pittsburg, Pa.

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Machine Shop Equipment, Methods, and Processes.
H. F. L. Orcutt, Rowington, England.

Automatics.
R. E. Flanders, M. Am. Soc. M. E., Springfield, Vt.

High Temperature Flames in Metal Working.
H. R. Swartley, Jr., Jersey City, N. J.

WEDNESDAY, September 22, 10 a.m.

(Session 3)

The Internal Combustion Engine of the Year 1915. *The Gas Power System. A Survey of its Status in the Year 1915.*
Prof. Charles Edward Lucke, Columbia University, New York.

The Development of the Construction of Turbines in the Netherlands.
D. Dresden, w. i., Mechanical Engr. for Messrs. Gebroeders Stork & Co., Hengelo, the Netherlands.

The 1915 Steam Turbine.
E. A. Forsberg, Stockholm, Sweden.

The Diesel Engine in America.
Max Rotter, M. Am. Soc. M. E., Chief Engineer, Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.

THURSDAY, September 23, 2 p.m.

(Session 4)

Developments in Modern Water Turbine Practice.
Dr. H. Zoelly, Soc. Swiss Eng. & Arch., Zürich. Ver. D. Ing.; Schiff-bautechnische Gesellschaft; Inter. Electrotechnical Commission, London; Escher, Wyss & Co., Zürich, Switzerland.

Water Wheels of Pressure Type.
Arnold Pfau, M. Am. Soc. M. E., Milwaukee, Wis.

Hydraulic Power Development and Use.
J. D. Galloway, M. Am. Soc. C. E., San Francisco.

Water Wheels of Impulse Type.
W. A. Doble, M. Am. Soc. M. E., San Francisco.

Canadian Hydraulic Power Development.
Charles H. Mitchell, C.E., M. I. C. E., M. Can. Soc. C. E., M. Am. Soc. C. E.; Consulting Engr. to Dominion Water Power Branch, Department of the Interior, Canada.

FRIDAY, September 24, 10 a.m.

(Session 5)

Safety Engineering.
Frederic Remsen Hutton, D.Sc.; Past Pres. Am. Soc. M. E. and Hon. Sec.; Vice-Pres. of the American Museum of Safety, New York.

Motor Vehicles; Passenger Type.
Ethelbert Favary, M. Soc. Auto. Eng., M. Aero. Soc., New York.

Motor Vehicles; Utility Type.
A. J. Slade, M. Am. Soc. M. E., New York.

Motor Tractors.
F. S. Davis, International Harvester Co., Chicago.

FRIDAY, September 24, 2 p.m.

(Session 6)

The Boiler of 1915.
Arthur D. Pratt, Asst. to Advisory Engr., The Babcock & Wilcox Co., New York.

Compressed Air in the Arts and Industries.
W. L. Saunders, Pres. Am. I. M. E., M. Am. Soc. M. E., Am. Soc. C. E., Pres. Ingersoll-Rand Co., New York.

Equipment, Processes and Methods for Boiler Shop.
E. C. Meier, Phoenixville, Pa.

Electrical Engineering

THURSDAY, September 23, 10 a.m.

(Session 1)

Economics of Electric Power Station Design.
H. F. Parshall, D. Sc., M. I. C. E., London, England.

The Water Power of Sweden.
Sven Lübeck, Stockholm, Sweden.

Electric Power in Canadian Industry.
Charles H. Mitchell, C. E., M. I. C. E., M. Can. Soc. C. E., M. Am. Soc. C. E. Consulting Engineer to Dominion Water Power Branch Dept. of the Interior, Toronto, Canada.

The Effect of Hydro-electric Power Transmission upon Economic and Social Conditions, with Special Reference to the U. S. of America.
Frank G. Baum, M. Am. Soc. C. E., M. Am. Soc. M. E., M. Am. I. E. E., San Francisco.

THURSDAY, September 23, 2 p.m.

(Session 2)

Electrical and Mechanical Installations of the Panama Canal.
Edward Schildhauer, Fel. A. I. E. E., M. Am. Soc. C. E., M. Am. Soc. M. E. Formerly Elect. and Mech. Engr., Panama Canal Commission, New York.

Electric Welding.
C. B. Auel, Director: Standards, Processes and Materials, Westinghouse El. & Mfg. Co., Pittsburg, Pa.

The Application of Electricity to the Heating of Metals.
F. L. Bishop, M. A. I. E. E.; Dean, School of Engineering, University of Pittsburg, Pittsburg, Pa.

The Electric Motor as an Economic Factor in Industrial Life.
David B. Rushmore, M. A. I. E. E., A. S. M. E., A. I. M. E., A. S. C. E.; Ch. Engr., Power and Min. Dept., General Electric Co., Schenectady, N. Y.

SATURDAY, September 25, 10 a.m.

(Session 3)

The Influence of the Electric Motor on Machine Tools.
A. L. DeLeeuw, M. Am. Soc. M. E., Elizabethport, N. J.

Effects of Electrolysis on Engineering Structures.
Albert F. Ganz, M. E.; Professor of Electrical Engineering, Stevens Institute of Technology, Hoboken, N. J.

The Mechanical Problems of the Electric Locomotive.
G. M. Eaton, Engineer Railway Division, Westinghouse Elect. & Mfg. Co., East Pittsburg, Pa.

On the Production of High Permeability in Iron.
Ernest Wilson, William Siemens Professor of Electrical Engr., King's College, London, England.

Mining Engineering

TUESDAY, September 21, 10 a.m.

(Session 1)

Economic and Social Influence of Mining.
W. H. Shockley, F. R. G. S., M. A. I. M. E., Min. and Metal. Soc. of A., Inst. Min. and Metal. London, Palo Alto, Cal.

Valuation of Metal Mines.
T. A. Rickard, A. R. S. M., M. A. I. M. E., M. Inst. M. and M., Editor of the Mining and Scientific Press, San Francisco.

The Valuation of Oil Lands and Properties.
M. E. Lombardi, M. Am. I. M. E., San Francisco.

Valuation of Coal Mines and Lands.
R. V. Norris, Editor.

Valuation of Anthracite Mines.
R. V. Norris, M. Am. I. M. E., M. Am. Soc. C. E., M. Am. Soc. M. E., Wilkes-Barre, Pa.

Valuation of Coal Lands.
Sam'l A. Taylor, C. E., M. A. S. C. E., M. A. I. M. E.; Consulting Civil and Mining Engineer, Pittsburg, Pa.

Evaluating Coal Properties in Western Canada.
R. W. Coulthard, Mining Engineer, Calgary, Alberta.

Valuation in France.
E. Gruner, Comité des Charbonnages, Paris, France.

WEDNESDAY, September 22, 10 a.m.

(Session 2)

Functions and Work of Exploration and Development Companies.
H. W. Turner, M. Am. Inst. M. E., San Francisco.

European Mining Finance.
J. L. Gallard, Mining Editor, *The Financial Times*, London, England.

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The Financing of Mines in the United States.
Lucius W. Mayer, M. Am. Inst. M. E.; Consulting Engineer, 14 Wall St., New York.

THURSDAY, September 23, 10 a.m.

(Session 3)

Organization and Staff of Mining Companies.
W. H. Shockley, F. R. G. S., M. Am. Inst. M. E., Min. and Metal. Soc. of A., Inst. Min. and Met. London, Palo Alto, Cal. R. E. Cranston, M. Am. Inst. M. E., Am. Soc. M. E., San Francisco.

Relations of Governments to Mining.
Horace V. Winchell, M. Am. Inst. M. E., State Mineralogist, Minneapolis, Minn.

Mine Inspection.
J. W. Paul, Am. State Mine Inspectors Assn., Bureau of Mines, Pittsburg, Pa.

Metallurgy

TUESDAY, September 21, 2 p.m.

(Session 1)

Symposium on Iron and Steel.
Edited by Henry M. Howe, B. S., A. M., LL. D., M. Am. Inst. M. E., Bedford Hills, New York.

Iron and Steel Castings.
John Howe Hall, M. Am. Inst. M. E., Am. Soc. for Testing Materials; Metallurgical Engr., Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

Metallography and the Hardening of Steel.
Albert Sauveur, M. Am. Inst. M. E., Professor of Metallurgy and Metallography in Harvard University.

Case Hardening of Steel.
F. Giolitti, Professor, Turin, Italy.

The Duplex Process of Steel Manufacture.
F. F. Lines, Maryland Steel Co., Sparrows Point, Md.

Methods of Preventing Piping in Steel Ingots.
Emil Gathmann, Am. Inst. M. E., Baltimore, Md.

THURSDAY, September 23, 10 a.m.

(Session 2)

Symposium on Copper.
Edited by E. P. Mathewson, M. Am. Inst. M. E., Mgr., Anaconda Copper Mining Company, Anaconda, Mont.

Progress in Copper Metallurgy.
Thomas T. Read, M. Am. Inst. M. E., San Francisco.

Advances in Copper Smelting.
Frederick Laist, M. Am. Inst. M. E., Anaconda, Mont.

Metallurgy of Copper in Japan.
R. Kondo, Tokyo, Japan.

Copper Metallurgy of the Southwest.
Dr. James Douglas, Hon. Mem. Am. Inst. M. E., New York.

Reduction Works—Copper Queen Consolidated Mining Company, Douglas, Arizona.
Forest Rutherford, M. Am. Inst. M. E., Copper Queen Cons. Mining Co., Douglas, Arizona.

Advances made in the Metallurgy of Copper, Globe District, Arizona.
L. O. Howard, M. Am. Inst. M. E., Old Dominion Copper Mining Co., Globe, Ariz.

Improvements in Design and Construction of Modern Copper Plants.
Chas. H. Repath, M. A. S. M. E., Los Angeles, Cal.

THURSDAY, September 23, 2 p.m.

(Session 3)

Symposium on Copper (Continued).

Leaching Copper Ores.
W. L. Austin, M. Am. Inst. M. E., Riverside, Cal.

The Metallography of Copper.
William Campbell, Ph. D., D. Sc., M. Am. Inst. M. E., Columbia University, New York.

Boronized Cast Copper.
Dr. E. Weintraub, West Lynn, Mass.

Electrolytic Refined Copper.
A. C. Clark, M. Am. Inst. M. E., Raritan Copper Co., Perth Amboy, N. J.

The Development of Electrolytic Copper Refining.
Lawrence Addicks, M. Am. Soc. M. E., Am. Inst. M. E., Am. Inst. E. E., Douglas, Arizona.

Physical Properties of Copper.
Carle R. Hayward, M. Am. Inst. M. E., Asst. Prof. of Mining Engrg. and Metallurgy, Mass. Institute of Technology, Boston, Mass.

FRIDAY, September 24, 10 a.m.

(Session 4)

Symposium on Gold and Silver.
Edited by C. W. Merrill, M. Am. Inst. M. E., San Francisco.

Coarse Crushing Plant; 1000 Tons Capacity.
G. O. Bradley, Consulting Engineer, San Francisco.

Crushing and Grinding.
L. D. Mills, M. Am. Inst. M. E., San Francisco; M. H. Kuryla, M. Am. Inst. M. E., San Francisco.

Solution of Gold and Silver Including Classification.
M. H. Kuryla, M. Am. Inst. M. E., San Francisco.

Filtration or Separation of Metal Bearing Solution from Slime Residue.
L. D. Mills, M. Am. Inst. M. E., San Francisco.

Precipitation.
G. H. Clevenger, M. Am. Inst. M. E., Leland Stanford Jr. University, California.

FRIDAY, September 24, 2 p.m.

(Session 4)

Symposium on the Metallurgy of Zinc.
Edited by Walter Renton Ingalls, M. Am. Inst. M. E., New York.

Some Main Points in the Economics of the Metallurgy of Zinc.
Walter Renton Ingalls, M. Am. Inst. M. E., New York.

The Development of Zinc Smelting in the United States.
George C. Stone, Chief Engineer, New Jersey Zinc Co., New York.

The Smelting and Refining of Lead.
Dr. H. O. Hofman, Boston.

Symposium on the Utilization of Fuels in Metallurgy.
Edited by C. H. Fulton, M. Am. Inst. M. E., Professor of Metallurgy, Case School of Applied Science, Cleveland Ohio.

Pulverized Coal in Reverberatory Furnaces.
D. H. Browne, M. Am. Inst. M. E., New York.

Burning Pulverized Coal in Copper Reverberatories.
E. P. Mathewson, M. Am. Inst. M. E., Anaconda, Mont.

Gas Producer Development.
Z. C. Kline, Engineer, Rhode Island Glass Co., Central Falls, R. I.

Surface Combustion (What is it?)
C. E. Lucke, M. Am. Soc. M. E., Professor of Mechanical Engineering, Columbia University, New York.

Ore Dressing.
Robert H. Richards, M. Am. Inst. M. E., Professor of Mining Engineering and Metallurgy, Mass. Inst. Technology, Boston.

Naval Architecture and Marine Engineering

TUESDAY, September 21, 10 a.m.

(Session 1)

Ship Calculation, Resistance and Propulsion.
D. W. Taylor, M. Soc. N. A. & M. E., Navy Department, Washington, D. C.

Ocean Freighters.
Ernest H. Rigg, M. I. N. A., M. S. N. & M. E., Camden, N. J.

Recent Developments in Japanese Shipbuilding.
Dr. S. Terano, Professor of Naval Architecture, Tokyo Imperial University, Tokyo, Japan.

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Bulk Freight Vessels of the Great Lakes.
Herbert C. Sadler, Professor, University of Michigan, Ann Arbor, Mich.

TUESDAY, September 21, 2 p.m.
(Session 2)

River, Lake, Bay and Sound Steamers of the United States.
Andrew Fletcher, M. S. N. A. & M. E., Hoboken, N. J.

Special Types of Cargo Steamers for the United Coast to Coast Trade Through the Panama Canal.
George W. Dickie, M. Am. Soc. M. E., S. N. A. & M. E., San Francisco.

The Development of the Sail Yacht, Steam Yacht and Motor Yacht in American Waters.
William Gardner, M. S. N. A. & M. E., New York.

The Lightship.
G. C. Cook, Department of Commerce, Light-House Service, Washington, D. C.

WEDNESDAY, September 22, 10 a.m.
(Session 3)

Warships of the First Line of Battle.
Colonel E. Ferretti, Naples, Italy.

The Submarine.
R. H. M. Robinson, M. Soc. N. A. & M. E., Managing Dir., Lake Torpedo Boat Co., Late Naval Constructor, U. S. Navy.

Present Condition of the Submarine.
Max A. Laubeuf, Late Chief Constructor, French Navy, Paris, France.

Modern Marine Gun Armament.
H. F. Leary, Lieutenant, U. S. N.

General Problem of Naval Warfare.
Lt. Comdr. D. W. Knox, U. S. N., Washington, D. C.

THURSDAY, September 23, 10 a.m.
(Session 4)

Marine Boilers and Boiler Room Equipment.
Charles F. Bailey, M. Soc. N. A. & M. E., Newport News S. B. & D. D. Co., Newport News, Va.

The Development of the Marine Steam Turbine.
Lt. Comdr. H. C. Dinger, U. S. N., Washington, D. C.

The Application of the Steam Turbine to Marine Propulsion.
J. F. Metten, M. S. N. A. & M. E., Ch. Engr., Wm. Cramp & Sons' S. & E. Bldg. Co., Philadelphia, Pa.

Recent Developments in Marine Engineering in Japan.
Dr. M. Tsutsumi, Ch. Engr. Surveyor, Japanese Mercantile Marine Bureau, Tokyo, Japan.

THURSDAY, September 23, 10 a.m.
(Session 5)

Coaling Plants and Floating Cranes of the Panama Canal.
F. H. Cooke, Civil Engineer, U. S. N., Balboa Heights, Canal Zone.

Cargo Handling Methods and Appliances.
H. McL. Harding, Formerly Consulting Engineer, Dept. of Docks of the City of New York, New York.

Some Economic Fundamentals of Freight Handling.
David B. Rushmore, M. A. I. E. E., A. S. M. E., A. I. M. E., A. S. C. E., Ch. Engr. Power and Min. Dept., Gen'l Elect. Co., Schenectady, N. Y.

The Modern Trend in American Marine Terminals.
Robt. H. Rogers, Power and Min. Eng. Dept., General Elect. Co., Schenectady, N. Y.

Cargo Handling Methods and Appliances.
James A. Jackson, Assoc. A. I. E. E., Power and Min. Eng. Dept., General Elect. Co., Schenectady, N. Y.

FRIDAY, September 24, 10 a.m.
(Session 6)

Fuel Oil.
E. H. Peabody, M. A. S. M. E., S. N. A. & M. E., Babcock & Wilcox Co., New York.

The Application of Diesel or Heavy Oil Engines to Marine Propulsion.
G. C. Davison, M. S. N. A. & M. E., M. Am. Soc. N. E. Groton, Conn.

The Diesel Motor Applied to Marine Purposes.
C. Kloos, Technical Director, Werkspoor, Amsterdam, The Netherlands.

FRIDAY, September 24, 2 p.m.
(Session 7)

Terminal Works, Drydocks and Wharves of the Panama Canal.
H. H. Rousseau, Asso. M. Am. Soc. C. E., Civil Engineer U. S. N., Engr. of Terminal Construction, the Panama Canal.

Aids to Navigation of the Panama Canal.
W. F. Beyer.

American Graving Dock Practice.
Leonard M. Cox, M. Am. Soc. C. E., Corps of Civ. Engrs., U. S. N., Washington, D. C.

Dry Docks Recently Built in Italy.
Prof. Luigi Luiggi, Dr. Sc., M. Am. Soc. C. E., M. Inst. C. E., Pres. Italian Society of Civil Engineers, Rome, Italy.

Miscellaneous

WEDNESDAY, September 22, 10 a.m.
(Session 1)
AVIATION

Aeronautics.
Dr. A. F. Zahm, Curtiss (Motor Co.,) Hammondsport, N. Y.

Arrival of the Aeroplane.
A. E. Berriman, Chief Engineer, The Daimler Co., Ltd., Coventry, England.

A Discussion Concerning the Theory of Sustentation and Expenditure of Power in Flight.
F. W. Lanchester, M. Inst. C. E., Birmingham, England.

Principles and Theories of Aerodynamics.
Lt. J. C. Hunsaker, Naval Constructor, U. S. N., Mass. Institute of Technology, Boston.

THURSDAY, September 23, 2 p.m.
(Session 2)
REFRIGERATION

Refrigeration.
J. F. Nickerson, *Ice and Refrigeration*, Chicago, Ill.

Refrigeration.
Thor Andersson, Stockholm, Sweden.

Refrigeration in France.
L. Marchis, Professor in the Faculty of Sciences of Paris, France.

FRIDAY, September 24, 10 a.m.
(Session 3)

Agricultural Engr. and Engineering Education.

Agriculture and the Engineer.
J. B. Davidson, M. Am. Soc. A. E., Am. Soc. M. E., Professor, Agricultural Engineering, Iowa State College, Ames, Iowa.

Some Observations on the Extent and Value of Farm Power Equipment.
Philip S. Rose, Editor *The American Thresherman*, Madison, Wis.

Some Considerations Regarding Engineering Education in America.
George F. Swain, M. Am. Soc. C. E., M. Am. Soc. M. E., Professor of Civil Engineering, Harvard University, Cambridge, Mass.

Technical Education for the Professions of Applied Science.
Ira N. Hollis, M. Am. Soc. M. E., President Worcester Polytechnic Institute, Worcester, Mass.

FRIDAY, September 24, 2 p.m.
(Session 4)
HEATING AND VENTILATION

Introductory Paper.
R. C. Carpenter, M. A. S. M. E., Professor of Experimental Engineering, Sibley College, Cornell University, Ithaca, N. Y.

Recent Developments in Heating and Ventilating Art.
D. D. Kimball, New York.

Vacuum, Vacuo-Vapor and Atmospheric Heating Systems.
Jas. D. Hoffman, M. Am. Soc. C. E., Professor of Mechanical Engineering, University of Nebraska, Lincoln, Neb.

Recent Developments in Ventilating Machinery.
W. H. Carrier, M. Am. Soc. M. E., Buffalo, N. Y.

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Summary of Recent Bids on California State Highway Work

The following summary gives the price named by the low bidder, who in most cases was awarded the contract, for the class of work. All prices are per cubic yard unless otherwise stated.

EXCAVATION WITHOUT CLASSIFICATION

December 14, 1914—Los Angeles county, Liebre Mountain southerly, Lee Moor Construction Co., Los Angeles, 41c.

December 14, 1914—Orange county, Gallivan to San Juan Capistrano, M.-R. Company, Los Angeles, 60c.

April 5, 1915—Tulare county, Goshen to northern boundary, W. A. Kettlewell & Sons, Sanger, 45c.

April 5, 1915—Yolo county, Davis to Yolo causeway, Palmer & McBryde, San Francisco, 30c.

April 5, 1915—Yolo county, By-pass to Sacramento river, Joe Lawrence, Broderick, 50c.

April 5, 1915—Yuba county, southerly boundary to Wheatland, E. E. Roddan & Son, Wheatland, 59c.

April 5, 1915—Orange county near Serra, Brashear-Burns Co., Los Angeles, 33½c.

April 26, 1915—Contra Costa county, Richmond to Pinole, Bates, Borland & Ayer, Oakland, 70c.

April 26, 1915—Sonoma county, Willow Brook to southerly boundary, Twohy Bros. Co., San Francisco, 48c.

April 26, 1915—Monterey county, Greenfield to point near King City, Highway Paving & Construction Co., Palo Alto, 60c.

April 26, 1915—Monterey county, Salinas to Lagunita, T. M. Burns, Sacramento, 50c.

May 24, 1915—Kings county, Hanford to easterly boundary, G. S. Benson & Sons, Los Angeles, 65c.

May 24, 1915—Los Angeles county, Saugus to Castaic, Kennedy & Williams, Los Angeles, 40c.

June 1, 1915—Humboldt county, Jordan creek to Rio Dell, L. F. Gerdetz, San Francisco, 50c.

June 1, 1915—Colusa county, Colusa Junction to northern boundary, L. F. Gerdetz, 45c.

June 1, 1915—Monterey county, Chualar to Salinas, W. A. Dontanville, Paso Robles, 60c.

July 6, 1915—Contra Costa county, El Ciervo to Eckley, Urban Construction Co., San Francisco, 36c.

July 6, 1915—Tulare county, Visalia to Goshen, White & Gaskill, Long Beach, 45c.

July 6, 1915—Tehama county, Red Bluff to northerly boundary, James Fitzpatrick, Sacramento, 45c.

July 6, 1915—Glenn county, Willows to Grapit, Taylor & Berliner, Los Angeles, 60c.

July 19, 1915—Santa Clara county, San Jose to Los Gatos, Marin Rock Co., San Anselmo, 57c.

July 19, 1915—Los Angeles county, Rancho Tujunga to La Canada, Andrew Holloway, Pasadena, 51c.

July 19, 1915—Alameda county, Livermore to Santa Rita, H. G. Vaughan Construction Co., San Francisco, 51½c.

July 26, 1915—Monterey county, Greenfield to Camphora, Highway Paving & Construction Co., San Francisco, 52½c.

July 26, 1915—San Luis Obispo county, Atascadero creek to Paso Robles, John D. Marsh, Bakersfield, 50c.

July 26, 1915—Marin county, Burdell to St. Vincent, R. B. Markle, Jr., San Francisco, 42c.

EARTH EXCAVATION

December 14, 1914—Siskiyou county near Hornbrook, E. T. Johnson, Portland, Oregon, 29c.

July 26, 1915—Santa Barbara county, Gaviota Pass to Zaca Station, C. H. Hudson, Los Angeles, 35c.

LOOSE ROCK EXCAVATION

December 14, 1914—Siskiyou county, near Hornbrook, E. T. Johnson, 49c.

July 26, 1915—Santa Barbara county, Gaviota Pass to Zaca Station, C. H. Hudson, 50c.

SOLID ROCK EXCAVATION

December 14, 1914—Siskiyou county, near Hornbrook, E. T. Johnson, 84c.

July 26, 1915—Santa Barbara county, Gaviota Pass to Zaca Station, C. H. Hudson, 70c.

CLASS B PORTLAND CEMENT CONCRETE IN CULVERTS AND MONUMENTS

State to furnish cement only

December 14, 1914—Los Angeles county, Liebre Mountain southerly, Lee Moor Construction Co., $16.

December 14, 1914—Orange county, Gallivan to San Juan Capistrano, M.-R. company, $12.

April 5, 1915—Orange county, near Serra, Brashear-Burns Co., $7.50.

April 26, 1915—Monterey county, Greenfield to point near Bradley, F. L. Smith & Co., Eureka, $12.

May 24, 1915—Los Angeles county, Saugus to Castaic, Kennedy & Williams, $10.

June 1, 1915—Humboldt county, Jordan creek to Rio Dell, L. F. Gerdetz, $14.

July 6, 1915—Tehama county, Red Bluff to northerly boundary, James Fitzpatrick, $11.

July 6, 1915—Contra Costa county, El Ciervo to Eckley, Urban Construction Co., $9.

July 19, 1915—Los Angeles county, Rancho Tujunga to La Canada, Andrew Holloway, $8.

CLASS B PORTLAND CEMENT CONCRETE IN STRUCTURES

State to furnish cement, sand, and coarse aggregate.

April 5, 1915—Tulare county, Goshen to northern boundary, W. A. Kettlewell & Sons, $10.

April 5, 1915—Yuba county, southerly boundary to Wheatland, E. E. Roddan & Son, $10.

April 5, 1915—Yolo county, By-pass to Sacramento river, Joe Lawrence, $6.

April 5, 1915—Yolo county, Davis to Yolo causeway, Palmer & McBryde, $15.

April 26, 1915—Monterey county, Greenfield to point near King City, Highway Paving & Construction Co. $10.50.

April 26, 1915—Monterey county, Salinas to Lagunita, T. M. Burns, $10.

April 26, 1915—Sonoma county, Willowbrook to southerly boundary, Twohy Bros. Co., $9.

April 26, 1915—Contra Costa county, Richmond to Pinole, Bates, Borland & Ayer, $10.

May 24, 1915—Kings county, Hanford to eastern boundary, G. S. Benson & Sons, $10.

June 1, 1915—Colusa county, Colusa Junction to northern boundary, L. F. Gerdetz, $9.

June 1, 1915—Monterey county from Chualar to Salinas, W. A. Dontanville, $9.50.

July 6, 1915—Glenn county, Willows to Grapit, Taylor & Berliner, $10.

July 6, 1915—Tulare county, Visalia to Goshen, White & Gaskill, $14.

July 19, 1915—Santa Clara county, San Jose to Los Gatos, Marin Rock Co., $9.50.

July 19, 1915—Alameda county, Livermore to Santa Rita, H. G. Vaughan Construction Co., $9.75.

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July 26, 1915—Marin county, Burdell to St. Vincent, R. B. Markle, Jr., $9.

July 26, 1915—Santa Barbara county, Gaviota Pass to Zaca station, C. H. Hudson, $10.

July 26, 1915—San Luis Obispo county, Atascadero creek to Paso Robles, John D. Marsh, $8.25.

July 26, 1915—Monterey county, Greenfield to Camphora, Highway Paving & Construction Co., $12.

CLASS B PORTLAND-CEMENT CONCRETE IN PAVEMENT

State to furnish cement, sand, and coarse aggregate.

December 14, 1914—Tulare county, Goshen to northern boundary, W. A. Kettlewell & Sons, $2.20.

April 5, 1915—Yuba county, southerly boundary to Wheatland, E. E. Roddan & Son, $3.

April 5, 1915—Yolo county, By-pass to Sacramento river, Joe Lawrence, $2.85.

April 5, 1915—Yolo county, Davis to Yolo causeway, Palmer & McBryde, $3.

April 26, 1915—Monterey county, Salinas to Lagunita, T. M. Burns, $4.25.

April 26, 1915—Sonoma county, Willowbrook to southerly boundary, Twohy Bros. Co., $2.64.

May 24, 1915—Kings county, Hanford to eastern boundary, G. S. Benson & Sons, $3.

June 1, 1915—Colusa county, Colusa Junction to northern boundary, L. F. Gerdetz, $3.

June 1, 1915—Monterey county, Chualar to Salinas, W. A. Dontanville, $2.55.

July 6, 1915—Glenn county, Willows to Grapit, Taylor & Berliner, $2.40.

July 6, 1915—Tulare county, Visalia to Goshen, White & Gaskill, $2.85.

July 19, 1915—Alameda county, Livermore to Santa Rita, H. G. Vaughan Construction Co., $2.59.

July 19, 1915—Santa Clara county, San Jose to Los Gatos, Marin Rock Co., $2.77.

July 26, 1915—San Luis Obispo county, Atascadero creek to Paso Robles, $2.90.

July 26, 1915—Monterey county, Greenfield to Camphora, Highway Paving & Construction Co., $3.40.

CLASS B PORTLAND-CEMENT CONCRETE IN PAVEMENT

State to furnish cement only.

December 14, 1914—Orange county, Gallivan to San Juan Capistrano, M.-R. Company, $4.

April 26, 1915—Monterey county, Greenfield to point near Bradley, F. L. Smith Co., $4.75.

April 26, 1915—Monterey county, Greenfield to point near King City, Highway Paving & Construction Co., $6.15.

May 24, 1915—Los Angeles county from Saugus to Castaic, Kennedy & Williams, $3.49.

July 19, 1915—Los Angeles county, Rancho Tujunga to La Canada, Andrew Holloway, $3.67.

Bids for placing corrugated iron pipe-culverts, the State furnishing the pipe, ranged from $0.30 to $1 per lin. ft. for 12-in. pipe, $0.35 to $0.75 for 15-in. pipe, $0.50 to $1.50 for 18-in. pipe, $0.60 to $0.75 for 21-in. pipe, $0.60 to $2 for 24-in. pipe, $0.70 to $1 for 30-in. pipe, and $1 to $2.50 for 36-in. pipe. Guard-fence cost from 30c. to 60c. per lin. ft. On a number of contracts the quantity of pipe used was so small that the bids were more or less arbitrary. Concrete retaining walls on work in Tehama county between Red Bluff and the northerly boundary, cost $9 per cu. yd., the State furnishing the cement. Dry-rubble retaining walls on work in Santa Barbara county between Atascadero creek and Paso Robles, cost $2 per cu. yd. Rubble-masonry walls on the same contract cost $3 per cu. yd., the State furnishing cement and sand. Dry-rubble walls in Siskiyou county near Hornbrook cost $2 per cu. yd. Slope-paving on this same contract cost $3 per cu. yd. Gravel-surfacing in Yolo county between By-pass and the Sacramento river, cost $1 per ton.

OIL PRODUCTION OF THE WORLD IN 1914

The quantity of petroleum entering the markets of the world in 1914 amounted to 400,483,489 bbl. according to statistics compiled under the supervision of J. D. Northrop of the U. S. Geological Survey. They are as follows:

	1914.		1913.	
Country.	Production.	%	Production.	%
United States	265,762,535	66.36	248,446,230	64.59
Russia	67,020,522	16.74	62,834,356	16.34
Mexico	21,188,427	5.29	25,902,439	6.73
Rumania	12,826,579	3.20	13,554,768	3.52
Dutch East Indies	*12,705,208	3.17	11,966,857	3.11
India	†8,000,000	2.00	7,930,149	2.06
Galicia	†5,033,350	1.26	7,818,130	2.03
Japan	‡2,738,378	.68	1,942,009	.51
Peru	1,917,802	.48	2,133,261	.55
Germany	†995,764	.25	†995,764	.26
Egypt	777,038	.19	94,635	.03
Trinidad	643,533	.16	503,616	.13
Canada	214,805	.05	228,080	.06
Italy	39,548	.01	47,256	.01
Other countries	**620,000	.16	†270,000	.07
Total	400,483,489	100.00	384,667,550	100.00

*Includes British Borneo; †Estimated; ‡Includes Formosa; **Includes 600,000 bbl. produced in Argentina.

The total of the world since 1857 is 5,593,262,936 bbl., of which the United States yielded 3,335,457,140, and Russia, 1,622,233,845 barrels.

WATER in a heavy stream poured directly upon the chip at the point where it is being removed from the steel forging by the tool permits an increase in the speed and allows of a 30 to 40% increase in the amount of work done; with cast-iron the gain is 16%.

Engineers' Note Book

TABLE SHOWING RELATIVE COST TO TAXPAYER OF DIFFERENT TYPES OF HARD-SURFACE PAVEMENT

The accompanying table, which is taken from a report prepared by the engineering firm of Reitze, Storey & Duffy, Inc., of Seattle, while calculated especially for conditions in western Washington, is of value in estimating the cost of proposed pavements in other parts of the country, provided that allowance is made for differences in cost of labor and materials.

TABLE SHOWING RELATIVE COST TO THE TAXPAYER OF HARD SURFACE PAVEMENTS IN WESTERN WASHINGTON

Covering a period of 10 years—Interest on Bonds figured at 7%—Prices are average for entire district. Table No. 3

	PAVEMENTS With 6" Base, 1:3:6					WEARING SURFACE ONLY Base 6" Brick, 1:3:6, Figured at $5.30 per Sq. Yd. for all Pavements				
	Concrete 6" Thick	Sheet Asphalt	Brick	Sandstone	Granite	Concrete	Sheet Asphalt	Brick	Sandstone	Granite
Original Cost per square yard	$1.10	$1.75	$2.60	$3.35	$3.70	$0.30	$0.85	$1.00	$2.45	$2.90
End of First Year	1.18	1.87	2.75	3.48	3.94	0.32	1.02	1.03	2.62	3.10
End of Second Year	1.26	2.00	2.97	3.72	4.23	.34	1.06	1.06	2.80	3.33
End of Third Year	1.35	2.14	3.18	3.98	4.53	.36	1.76	1.20	3.00	3.56
End of Fourth Year	1.44	2.29	3.40	4.26	4.85	.38	1.24	1.38	3.21	3.80
End of Fifth Year	1.54	2.43	3.64	4.56	5.19	.41	1.33	1.62	3.43	4.07
End of Sixth Year	1.65	2.62	3.89	4.88	5.56	.44	1.42	1.70	3.67	4.36
End of Seventh Year	1.77	2.80	4.16	5.22	5.94	.47	1.52	1.88	3.93	4.66
End of Eighth Year	1.89	3.00	4.45	5.58	6.36	.50	1.63	1.98	4.21	4.98
End of Ninth Year	2.01	3.21	4.76	5.97	6.80	.54	1.74	2.29	4.50	5.33
End of Tenth Year	2.15	3.43	5.09	6.39	7.27	.58	1.86	2.52	4.82	5.70
Saving per square yard by use of Concrete		$1.28	$2.94	$4.24	$5.12		$1.28	$2.94	$4.24	$5.12
Original Cost per mile for 16' Roadway	$10,326.00	$16,427.00	$24,408.00	.....	.....	$2,816.00	$8,017.00	$16,896.00	.....	.....
Cost per mile for 16' Roadway at end of Tenth Year	$20,151.00	$32,196.00	$47,778.00	.....	.....	$5,444.00	$17,480.00	$33,041.00	.....	.....
Saving per mile of 16' Roadway by use of Concrete at end of Tenth Year		$12,015.00	$27,587.00	.....	.....		$12,015.00	$27,587.00	.....	.....

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Industrial Progress

ROTARY DISTRIBUTION OF CONCRETE FOR HIGHWAYS AND STREETS

Securing a uniform and thoroughly mixed concrete base is one of the most important problems in the construction of pavement for highways and city streets. It has been found in many instances that the concrete has disintegrated after drying out, owing to the fact that while placing the concrete, the stone or coarse aggregate separated from the cement and sand, making a concrete that was not homogeneous. The earliest method of mixing and distributing concrete for streets or highways was to use a stationary side-dump mixer placed at a street intersection or other convenient point and to distribute the concrete on the street or highway with wheelbarrows or horse-drawn carts. To save time and avoid damaging the sub-grade, some of the mixer manufacturers turned the mixing-drum endwise and added a traction device. By dumping the unmixed material in long piles down the centre of the street and using a gravity chute or a bucket operating on the boom, it was possible to lay the concrete base without wheelbarrows or carts.

The more sloppy concrete is, the quicker it will run down a

THE CHICAGO PAVING MIXER.

gravity chute, but the rock, being heavier, runs away from the fine material and is deposited in one place. As the chute is moved across the pavement the fine material is often deposited at some distance from the rock. If a sloppy batch of concrete is dumped from a bucket, the rock, having settled to the bottom of the bucket, hits the sub-grade first and the soft material splashes over the surrounding sub-grade instead of remaining with the rock.

To eliminate these difficulties and to preserve the reputation of concrete roads, the T. L. Smith Company of Milwaukee discarded the gravity chute, bucket, and boom about eight years ago and developed a rotary distributer for placing concrete on highways or city streets. This rotary distributer consists of a long circular shell or pipe 18 in. diam. and 15 to 20 ft. long. On the inside of this shell or pipe are 40 or 50 small blades, attached directly to the shell and set at such an angle as to mix the concrete and at the same time force it along the pipe or rotary distributer as it revolves. This revolving motion is secured by means of a sprocket and chain. The concrete is dumped into the distributer from the mixing-drum. Owing to the small incline at which the blades are set and the slight fall in the rotary itself the concrete is thoroughly mixed as it travels down the distributer.

This distributer is the standard equipment on what is known as the Chicago Paving Mixer. Another feature of interest on this mixer is the loading-skip, which is 8 ft. 6 in. wide at the bottom and 4 ft. 6 in. wide at the nose, or almost double the width found on the usual paving mixer. In 1914 Chicago Paving Mixers were used to lay 272 miles out of the total of 365.8 miles of concrete base laid on the California state highway.

Hints on Practice

CONCRETE FOUNDATIONS FOR SMALL GAS-ENGINES

To obtain the highest efficiency an engine should have a heavy and firm foundation. This will not only reduce wear and tear from vibration, but will also result in prolonged and better service. Rigidity and durability in the foundation are best obtained through the use of concrete. The concrete should be mixed in the proportion of 1 part portland cement, 3 parts clean, well-graded sand, and 5 parts crushed stone or gravel. The use of accurate measuring-boxes is advisable. The sand should pass a ¼-in. mesh sieve, and the crushed stone or gravel should pass readily through a 1½-in. opening. In no case should bank-run gravel be used without being screened. If the size of the engine warrants the use of a reinforced-concrete footing, a 1:2:4 mix should be used for the reinforced portion of the concrete. Sufficient water should be used to form a plastic mixture but not enough to cause separation of the cement and aggregates when placed.

After the exact position of the centre line of the foundation has been determined, a pit two to four feet deep should be excavated, the same size as the footing. The concrete should be deposited to the depth determined on the plan. In order to key the engine foundation to the footing, stones three or four inches in diameter should be embedded in the portion of the footing under the engine so that they will protrude from the footing. A box-form eight inches larger in both length and width than the engine-base should be carefully set over the footing. The inside of the forms should be oiled to prevent the concrete from adhering to same. It is essential that the anchor bolts for the engine be carefully spaced and so placed as to take care of any small variations in position. A templet should be used, also greased gas-pipes twice the diameter of the bolts. The purpose of the pipes is to provide for such slight adjustments of bolts as may be required. The anchor-bolts should be embedded in the concrete at least 18 in. and should be supplied with cast-iron washers at the lower ends. When the templet has been accurately set over the forms and the bolts so arranged that the tops are at proper elevation, the concrete is deposited carefully and spaded in the form. The gas-pipes should be turned from time to time, thus preventing them from sticking to the concrete. The concrete next to the form should be carefully spaded to prevent the formation of air-bubbles or pockets. Damp burlap should be placed over the form after the concrete is placed. This will insure normal setting of the material. After twenty-four hours the form can be removed. The engine may be set and the bolts adjusted after forty-eight hours. Before the engine is set the gas-pipes should be removed and when the engine is finally placed, the space around the bolts filled with 1:1 mortar. The engine should not be used until the concrete is at least two weeks old. If it is necessary to have an exhaust or drain pipe, this may be set in the form before the concrete is deposited.

STEEL-PLATES were coated with three different thicknesses of cement and immersed for three years in sea-water near the dry dock at Mt. Hope, Canal Zone, Isthmus of Panama. The 1-in. coating did as well as the 1½-in. None of the coatings afforded sufficient protection to insure the permanence of structures dependent on such protection, but the life of such structures can be considerably prolonged by a cement-coating only ½ in. thick.

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Construction News Summary

PRESENT STATUS OF ENGINEERING PROJECTS ON THE PACIFIC COAST

(Engineers and others connected with construction work are invited to make use of these columns to acquaint other members of the profession and the general public with the progress of work under their charge.)

PROJECTS OF UNITED STATES RECLAMATION SERVICE

UMATILLA PROJECT, OREGON—A force of 25 men has been working on main canal. During the month, 35,000 cu. yd. of material has been removed by force account, and 10,000 cu. yd. by contract work. The canal has been lined for 13,000 lin. ft. with concrete 3 in. thick, involving the placing of 3600 cu. yd. H. D. Newell is project manager.

GOVERNMENT RAILROAD IN ALASKA

Station-men are at work on 25 miles on line. A number of contracts for piles and ties has been awarded. Work for repairing Alaska Northern railroad is now under way.

GENERAL CONSTRUCTION IN WASHINGTON

Willapa harbor extension of Chicago, Milwaukee & Puget Sound railroad has been completed. Line runs from Maytown, 66 miles to Raymond. State highway commission has awarded contracts for the construction of 20 miles of highway, costing $45,000.

GENERAL CONSTRUCTION IN OREGON

Steel for main span of interstate bridge between Portland and Vancouver, Washington, has been assembled. Excavation for the South Fork pipe-line at Oregon City has been completed and most of the pipe has been laid. Contracts for the construction of the remaining four miles of the Multnomah County 70-mile highway system have been awarded and five miles of highway has been completed.

GENERAL CONSTRUCTION IN CALIFORNIA

GOVERNMENT WORK ON SACRAMENTO RIVER—Two dredges are working on the channel near Rio Vista. During July, 609,707 cu. yd. of material was moved.

SHELL PIPE-LINE—Line from Coalinga to Martinez has been completed and placed in operation. Sanderson & Porter are engineers.

STATE HARBOR WORK AT SAN FRANCISCO—Ferry postoffice has been completed and occupied. Progress has been made on the construction of pier 24 and pier 35.

KINGS COUNTY HIGHWAYS—Contracts for furnishing asphaltum and crushed rock as well as for the construction of three miles of highway have been awarded.

ORANGE COUNTY HIGHWAYS—Contracts have been awarded for 124 miles of road, 115 miles has been graded, concrete has been laid on 106 miles, and 113 miles has been completed, the plans not calling for concrete on all roads. S. H. Finley is chief engineer and George R. Wells, office engineer.

Repairs on Northern Electric railroad between Meridian and Colusa are nearly completed, and service will be resumed in September. Atchison, Topeka & Santa Fe railroad's line from Minkler to Lindsay has been completed and turned over to operating department. California Natural Gas Company's line from the Buena Vista hills to Waits, near Bakersfield, has been completed. Harbor dredging at San Diego has been completed.

General Summary

Condensed From Our Daily Construction News Service.

CALIFORNIA

BAKERSFIELD—Castro & Blaisdell were low bidders for construction of road between Bena and Caliente, 9¾ miles, at 40c. per cu. yd. for 175,000 cu. yd. excavation, $18 per cu. yd. for 105.1 cu. yd. concrete, 70c. per cu. yd. for 105.1 lin. ft. of creosoted Oregon pine piling, $58 per M for 200,467 ft. B.M., Oregon pine lumber, 5c. per lin. ft. for 95,600 lin. ft. barbed wire fence, $1.55 per lin. ft. for 2530 lin. ft. 18-in. corrugated pipe, $2 per lin. ft. for 425 ft. 25-in. pipe, $3.35 per lin. ft. for 345 ft. 36-in. pipe, 45c. per lin. ft. for 10,600 lin. ft. guard fence, a total of $100,467.34.——Shattuck & Nimmo Warehouse Co. were low bidders at $25,041.90 for construction of 5⅛ miles of Bakersfield-Glennville road, unit prices being as follows: 30,820 cu. yd. excavation at 48½c., 116.8 cu. yd. concrete at $25, 1252 lb. steel rods at 4c., 1265 ft. B.M. Oregon pine lumber at $64 per M, 52,670 lin. ft. barbed wire fence at 7c., 849 lin. ft. 18-in. corrugated pipe at $2.15, 79 lin. ft. of 24-in. pipe at $2.54, 45 lin. ft. of 36-in. at $3.65, 88 lin. ft. of 48-in. at $5, 118 lin. ft. of 60-in. at $6, and 36 lin. ft. of guard fence at 50c.——Leigh G. Garnsey, Long Beach, was low bidder at $28,858.58 for construction of 6¼ miles of highway between Bakersfield and Edison, unit prices being as follows: 6700 cu. yd. excavation at 38c., 32,900 lin. ft. shaping roadbed at 4c., 58,841 sq. yd. concrete pavement at 40c., 51.3 cu. yd. concrete in structures at $9.40, 600 lb. steel rods at 5c., 38 lin. ft. 24-in. corrugated pipe at $1.86, 112 lin. ft. 66-in. pipe at $8.60, 132 lin. ft. standard guard fence at 44c.——Supervisor J. H. Thornber has reported in favor of proposed road from Weldon in Kern River canyon to summit of Mount Whitney.

BERKELEY—Plans are being considered for formation of water district in conjunction with City of Albany.——City council has adopted resolutions of intention for the construction of $750,000 worth of permanent pavement.——Plans are being prepared for three electrolier lighting-districts. F. T. Robson is commissioner of public works.

BUTTONWILLOW—Miller & Lux, Merchants Exchange Bdg., San Francisco, are dredging channel from Buena Vista lake to their headquarter's ranch.

DUNSMUIR—City will construct 1¼ miles of concrete pavement; work will be done by day labor under direction of P. M. Lau, city engineer.

EAST SAN DIEGO—Contract for improving Hugo avenue and cross streets was awarded to Olaf Nelson for 45c. per cu. yd. for excavation, $1.55 per cu. yd. for decomposed granite, 34c. per lin. ft. for concrete curb, 12c. per sq. ft. for sidewalk, 7½c. per sq. ft. for cobblestone gutter, a total of $40,532.92.

EUREKA—Contract for construction of suspension bridge over Salt river at Ballou's Ford has been awarded to Frank L. Smith for $16,490.——Contract for furnishing rock for the north jetty of the harbor has been awarded to Pacific Engineering Co. Rock will be obtained from the Minor quarries near Arcata.

FAIRFIELD—Board of Supervisors will receive bids at its September meeting for construction of three bridges on state highway.

FRESNO—Contract for construction of sidewalks on Van Ness avenue has been awarded to Kaufield & Knickerbocker for 9.45c. per sq. ft. Contract for sewers on blocks 364 and 375 has been awarded to Thompson Bros. for 48c. per lin. ft.——Contract for construction of concrete bridge over Fish slough on Elkhorn grade has been awarded to J. E. Mitchell for $11,974.

GIANT—Additions costing $500,000 will be made to plant of Giant Powder Co., now owned by Atlas Powder Co., Wilmington, Delaware.

GRIDLEY—E. W. McKussick is preparing for drainage system for reclamation district No. 833. Bond election wil probably be called in about four weeks. James Ownby is secretary.

HANFORD—Contract for furnishing 1000 tons of asphaltum for county highways has been awarded to G. C. Aydelott for $4.10 per ton f.o.b. Bakersfield; $5.70 f.o.b. Hanford; and $5.90 f.o.b. Armona and Lemoore.

HERMOSA BEACH—Contract for improving Bay View drive has been awarded to California-Arizona Construction Co., 1700 East Washington street, Los Angeles, for 11.2c. per lin. ft. for redwood curbs, 17.9c. per sq. ft. for asphalt concrete, and $1.33 per lin. ft. for 6-in. sewer pipe.

HILLSBORO—Bonds for $70,000; $40,000 for construction of roads and $30,000 for construction of school have been voted.

LINDSAY—City Council is considering construction of additional pavement. Eugene Barieau and W. B. Kiggens have been appointed to visit other cities with a view to determining the type of pavement to be used.

LIVERMORE—Contract for paving 24-ft. strip on East First street has been awarded to California Bitulithic Co., 4030 Hollis street, Oakland, for $14,225.

LOS ANGELES—Bids will be received until 11 a.m., September 10, at U. S. Engineer Office, Central Bdg., for furnishing and delivering at San Diego, the following: one guy derrick of 5 tons capacity, mast of Oregon pine, 16 by 16-in. by 90 ft. long, boom 14 by 14-in. by 80 ft. long; one set of derrick irons and sheaves; one four-rod boom truss; one 16-ft. bull-wheel with two guide sheaves not less than 14 in. diam., grooved to fit ⅝-in. wire rope; one electric derrick hoist. Detail specifications

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at office of 'Western Engineering.'——D. D. Chapman, 216 North Johnstone street, has been awarded contract for improvements in road district No. 3 for $11,472.78.——Ford & Stout, Bradbury Bdg., have been awarded the contract for improving Andrews boulevard for 1.5c. per sq. ft. for grading, 10.2c. per sq. ft. for asphalt pavement, 30c. per lin. ft. for curbs, 10c. per sq. ft. for sidewalk, 14c. per sq. ft. for concrete gutter, 40c. per sq. ft. for granite block gutter; a total of $18,703.58.——Contract for improving Westminster avenue has been awarded to California-Arizona Construction Co., 1700 East Washington street, for 1.8c. per sq. ft. for grading, 14.8c. per sq. ft. for warrenite paving, 30c. per lin ft. for curbs, 40c. per sq. ft. for granite block gutter. ——Contract for improving Court street has been awarded to E. A. Baker, H. W. Hellman Bdg., for 6½c. per sq. ft. for grading, 2c. per sq. ft. for tamping and oiling, 30c. per lin. ft. for curbs, 10c. per sq. ft. for sidewalk, 13c. per sq. ft. for concrete gutter, a total of $4652.73.——Contract for improving Sierra Bonita avenue has been awarded to J. R. Radonich, for 1c. per sq. ft. for grading, 12¼c. per sq. ft. for concrete paving, 30c. per lin. ft. for concrete curb, 10c. per sq. ft. for sidewalks, a total of $3441.34.——Contract for furnishing asphaltic cement to city for one year has been awarded to Standard Oil Co. for $8 per ton.——Bond issue of $3,000,000 for extension of county highway system has been proposed. Supervisor Hinshaw is chairman of committee on highways.——Board of consulting engineers composed of H. Hawgood, Charles T. Leeds, J. B. Lippincott, F. H. Olmstead, and J. W. Reagan has reported in favor of flood-control plan costing $9,500,000.——Contract for construction of sidewalk on Oxford avenue has been awarded to J. R. Radonich, 1226 Sunset boulevard, for 11¼c. per sq. ft. ——Bids will be received until 11 a.m., September 8, at U S. Engineer Office, Central Bdg., for furnishing and delivering at San Diego the following: One batch concrete mixer, capacity 22 cu. ft., driven by electric motor; one batch concrete mixer, 12 ft. capacity, driven by electric motor. Current for both of these to be 3-phase, 60-cycle, 220-volt.——Contract for construction of 18,086 sq. ft. of cement sidewalk on 14th street has been awarded to W. J. F. Liddington, 420 E. 60th street, for $2170.——Independent Producers' Agency, Union Oil Bdg., will construct storage for 1,000,000 bbl. of oil.——Southern California Contracting Co., Washington Bdg., has been awarded the contract for improving Hillcrest court at 1c. per sq. ft. for grading, 10c. per sq. ft. for oil macadam pavement, and 16c. per sq. ft. for concrete gutter, a total of $1632.66.

MADERA—Property owners are considering formation of irrigation district. J. L. Butin is interested.

MARTINEZ—Contract for paving three miles of road from Alameda tunnel to Walnut Creek has been awarded to Raisch Improvement Co., Crocker Bdg., San Francisco, for $35,625.——Contract for construction of bridge over Avon slough on Bay Point road has been awarded to Healy-Tibbets Co., Main and Market streets, San Francisco, for $6932.

MARYSVILLE—Three miles of road will be graveled in district No. 10. Estimated cost is $5600. L. B. Crook is county surveyor.

MERCED—San Joaquin Light & Power Co. will construct plant costing $65,000 at Merced Falls. R. Casad is local manager.

MODESTO—Contract for construction of bridge across Tuolumne river at Knights Ferry has been awarded to Ross Construction Co., Sacramento, for $29,870.——Petition has been presented to board of supervisors for a road-bond election. T. H. Kewin is interested.——Contract for construction of Dry Creek crossing has been awarded to Ernest Green for $60,602.95. This is the last large contract to be awarded by the Modesto irrigation district this year.——George E. Freitas, city engineer, has prepared plans for street work costing $20,664.25 for coming year.

NEVADA CITY—Council is considering construction of cement sidewalks throughout city.

NEWPORT BEACH—I. B. Funk, 514 Central Bdg., Los Angeles, is preparing plans for beach protection.

OAKLAND—Contract for improvement of 69th avenue has been awarded to P. Mathiesen for 1¼c. per sq. ft. for grading; 35c. per lin. ft. for concrete curb; 14c. per lin. ft. for concrete gutter, 9c. per sq. ft. for oil macadam pavement; 9c. per sq. ft. for cement sidewalk; 60c. per lin. ft. for 8-in. sewer; $10 each for lampholes, $2.60 per lin. ft. for 8 by 29-in. corrugated iron and concrete culvert.——Contract for improving Vermont street has been awarded to Hutchinson Co., 13th and Franklin streets, for 40c. per cu. yd. for excavation, 11c. per lin. ft. for redwood curb, 15c. per sq. ft. for concrete gutter, 10½c. per sq. ft. for oil macadam pavement, and $2.25 per lin. ft. for 8 to 24-in. corrugated iron and concrete culvert.——Contract for improving Foothill boulevard has been awarded to Hutchinson Co. for 3c. per sq. ft. for grading, 55c. per lin. ft. for concrete curbs, 20c. per sq. ft. for concrete gutter, and 12c. per sq. ft. for oil macadam pavement.——Contract for improving 62nd avenue has been awarded to D. U. Toffelmier, for 1¾c. per sq. ft. for grading, 12c. per lin. ft. for redwood curb; 14c. per sq. ft. for concrete gutter; 10c. per sq. ft. for oil macadam pavement, and 11c. per sq. ft. for cement sidewalk.——Bids will be received until 10 a.m., September 7, by George E. Gross, county clerk, for grading and paving with bitulithic pavement on 4-in. concrete base, of county roads from town line of Livermore to state highway.

ONTARIO—Contract for paving A street, which had been awarded to L. G. Garnsey, Los Angeles, has been rescinded on account of legal complications, and work has been postponed indefinitely.

ORLAND—Citizens of town and farmers on U. S. Reclamation project are considering construction of light and power plant.

OROVILLE—Contract for construction of pavement on Montgomery street has been awarded to Clark & Henery Construction Co., Sacramento, for 60c. per cu. yd. for excavation, 80c. per cu. yd. for embankment, and 12.9c. per sq. ft. for warrenite pavement.——Board of supervisors will receive bids until September 7 for construction of hall of records. Estimated cost is $55,000. Charles Kaiser, Mechanics Institute Bdg., San Francisco, is architect.——Western Canal Co. is securing right-of-way for extension of main canal, and will start construction in fall.

PASADENA—Bids will be received until September 7, by H. Dyer, city clerk, for construction of 52,000 sq. ft. of 5-in. concrete pavement on Glenarm street.——Bids will also be received until the same time for construction of northwest storm drain, including 3205 lin. ft. reinforced concrete pipe. Estimated cost is $32,000. R. V. Orbison is city engineer.——Contract for alley improvements has been awarded to Andrew Holloway, 451 South Broadway, for 18c. per sq. ft. for asphaltic concrete.——Contract for improving Main street has been awarded to George R. Curtis, 552 South St. Louis street, for 14½c. per sq. ft. for topeka pavement on concrete base, 30c. for curbs, $1 per lin. ft. for 6-in. sewer and $1.50 for 12-in. sewer, a total of $66,687.

PORTERSVILLE—All bids for construction of pavement around high-school grounds have been rejected and new ones will be called for.——Contract for paving several streets with 5-in. concrete base and 1½-in. topeka wearing surface has been awarded to Federal Construction Co., Sharon Bdg., San Francisco, for 12.83c. per sq. ft.——City engineer I. H. Althouse is preparing plans for paving on additional streets.——Southern Pacific Co. will build new steel and concrete bridge over White river. Track on this division will be re-ballasted and 90-lb. rails laid.

RED BLUFF—Contract for construction of concrete bridge 2000 ft. long over Sand slough has been awarded to Ross Construction Co., Sacramento, for $109,000. Contract for construction of two other concrete bridges has been awarded to McLaren & Peterson, San Francisco, for $31,000.

REDONDO BEACH—Contract for construction of municipal pier has been awarded to Leyden-Ortseifen Co., Chicago, for $108,800.

REDWOOD CITY—Contract for construction of road from Pescadero to Santa Cruz county line has been awarded to Lou G. Hare, Salinas, for about $29,000. Contract for construction of bridges on same road has been awarded to Henry Layaz for about $3000.——City trustees are considering construction of electrolier system on Broadway. H. H. Sears is city engineer.

RICHMOND—Contract for grading and construction of oil macadam pavement in several new townsites near Walnut Creek has been awarded to George W. Cushing, 420 Macdonald avenue.

RIVERBANK—Petition has been presented to supervisors for construction of bridge across Stanislaus river at this point.

RIVERSIDE—Contract for construction of 8.67 miles of highway has been awarded to Conner Contracting Co., 709 Higgins Bdg., Los Angeles, for $28,010.30.——Contract for construction of 60-ft. reinforced concrete bridge has been awarded to Munoz & Munoz, 800 Central Bdg., Los Angeles, for $2938.

SACRAMENTO—Contract for construction of state highway in San Luis Obispo county has been awarded to John D. Marsh, Bakersfield, for $67,809.45.——Contract for construction of highway between Greenfield and Camphora in Monterey county has been awarded to Highway Paving & Construction Co., San Francisco, for $54,507.——Contract for construction of highway in Santa Barbara county between Gaviota and Zaca station has been awarded to C. H. Hudson, Los Angeles, for $54,586.——Contract for surfacing highway in town of Arbuckle has been awarded to Clark & Henery Construction Co. for $5778.75.——Contract for construction of highway in Marin county, between Burdell and St. Vincent, has been awarded to R. B. Markle, Jr., for $21,255.40.——Bids will be received until noon, September 15, by W. F. McClure, state engineer, for construction of walls and walks at California Institution for Deaf and Blind, Berkeley. Bids will also be received until noon, September 16, for construction of tank tower at Home for Adult Blind, Berkeley. Plans and specifications from Department of Engineering upon deposit of $5.——Sacramento Good Roads Association has prepared plans for county highway system containing 175 miles of improved highways. H. A. French and J. E. Langdon are in-

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terested.——Contract for construction of state highway lateral from Goshen to Kings county line has been awarded to White & Gaskill, Long Beach.——Bids will be received until noon, September 14, by W. F. McClure, state engineer, for construction of two cottages at state hospital at Patton. Plans and specifications from Department of Engineering, upon deposit of $15.——Natomas Consolidated Co. and Sacramento county will build 1400-ft. trestle costing $29,500 to connect reclamation district No. 1400, with 12th street bridge.——State Highway Commission will take over road from Sacramento to Galt. Repairs will be made costing about $30,000.——Bids will soon be received by W. F. McClure, state engineer, for construction of various engineering projects authorized by last legislature, for which funds are now available. Total estimated cost is $176,400.

SALINAS—Contract for construction of bridge at Bradley over Salinas river has been awarded to W. L. Gillham & Son, for $14,400.——Contract for construction of bridge at San Lucas has been awarded to McLaren & Petersen, San Francisco, for $18,000.——Contract for river-bank protection at Hilltown bridge has been awarded to Lou G. Hare for $5447.——City engineer Davies is preparing plans for storm-sewer system.

SAN ANSELMO—City planning commission is preparing extensive plans for civic improvements.

SAN BERNARDINO—Contract for improving 4th street has been awarded to Highway Construction Co., for 9½c. per sq. ft. for 4-in. concrete pavement with oiled screening surface, 22c. per lin. ft. for curbs, and 9c. per sq. ft. for concrete sidewalks.

SAN DIEGO—Contract for construction of concrete conduit-pipes has been awarded to Hunt, Mirk & Co., 141 Second St., San Francisco, for $90,000.——Mass-meeting has recommended bond issue for $2,000,000 for construction of county highway system. Edward F. Stahle is interested.——Bids will be received until 7:30 p.m., September 13, by S. W. Belding, 324 Marston Bdg., for furnishing one 12-in. screw-cutting engine-lathe and one 12-in. chuck.

SAN FRANCISCO—Plans have been prepared by M. M. O'Shaughnessy, city engineer, for esplanade along beach from Cliff House southerly. Estimated cost is $1,000,000. The first part, for which $50,000 has already been appropriated, will soon be started. Considerable concrete seawall will be constructed.——City engineer M. M. O'Shaughnessy has completed plans for construction of scenic boulevard around Twin Peaks and bids will soon be received. Estimated cost is $114,000.——Contract for repairing pier No. 32 has been awarded to Tibbetts Pacific Co.——Contract for construction of 75,000-bbl. tank steamer for Union Oil Co. has been awarded to Union Iron Works, for $1,000,000.——City Street Improvement Co., 166 Geary St., has been awarded contract for paving boulevard between Lincoln and Presidio, including laying sidewalks and sewers. Estimated cost is $65,000.

SAN JOSE—Bids will be received until 11 a.m., September 7, by H. A. Pfister, county clerk, for improvement and enlargement of Canoas Creek by-pass, including considerable concrete work. I. L. Ryder is county surveyor.——Southern Pacific Co. will build union depot on West Santa Clara street, also several miles of new track to reduce distance on its main line. Estimated cost is $1,000,000.

SAN LUIS OBISPO—Following contracts have been awarded for bridges: 6-ft. culvert, 22-ft. reinforced concrete 'T-beam' bridge, and large reinforced concrete bridge to Allison & Cole Construction Co., for $494, $1125, and $8199 respectively; 34-ft. reinforced concrete 'T-beam' bridge to Boardman Construction Co., Los Angeles, for $2230; and 12-ft. concrete slab bridge to A. Nyberg for $600.——Board of supervisors will receive bids until September 8, for construction of reclamation work on Santa Maria river, including 2300 lin. ft. of construction of Dean deflector system. Estimated cost is $18,000.——Bids will also be received until the same time for construction of bridge, composed of two 85-ft. steel riveted spans, over Paso Robles creek on state highway. Further information of both these jobs from F. J. Rodrigues, county clerk. A. F. Parsons is county surveyor.

SAN MATEO—Contract for construction of pavement at upper end of San Mateo Park, has been awarded to Ransome-Crummey Co., First Savings Bank Bdg., Oakland, for $70,850. Contract for paving several other streets has been awarded to Federal Construction Co., Sharon Bdg., San Francisco, for $77,800.

SANTA ANA—Contract for construction of Yorba Linda road has been awarded to Max L. Hubermann, for 25c. per cu. yd. for excavation; 8c. per lin. ft. for shaping roadbed; $1.85 per cu. yd. for class B concrete in roadbed, $10 per cu. yd. for class A concrete and for class B and class C concrete in bridges; $1.95 per lin. ft. for 18-in. corrugated pipe; $3.50 per lin. ft. for 30-in. pipe; 4c. per lb. for reinforcing steel; 50c. per lin. ft. for guard fence; $1.25 per lin. ft. for pipe-railing; a total of $10,695.78. Engineer's estimate was $11,072.08. Other bidders were Oscar Ford, $11,984.50; M-R Construction Co., $13,345.53; J. Driskill, $13,913.77; O. & C. Construction Co., $16,385.80.——Fred Hoffman was awarded contract for construction of 5½ miles of Santiago boulevard at 22c. per cu. yd. for excavation, 8c. per lin. ft. for shaping roadbed, $8 per cu. yd. for concrete in structures; $2.10 per cu. yd. for concrete in pavement; $1 per lin. ft. for 12-in. corrugated pipe; $1.50 for 15-in., $2 for 18-in., 4c. per lb. for reinforcing steel; 50c. per lin. ft. for guard fence; $1.50 per lin. ft. for pipe rail, and $4 per lin. ft. for 36-in. corrugated pipe, a total of $19,498. Engineers' estimate was $23,951.41. County furnishes cement, sand, and coarse aggregate. Other bidders were Max L. Hubermann, $21,428.80; Hart & Ducey, $22,149.85; Isbell Construction Co., $23,957.60; J. Driskill, $26,045.70; Oscar Ford, $27,631; O. & C. Construction Co., $30,044.33; C. L. Hyde Construction Co., $31,877.——Contract for improvement of several county highways, including First street, Main street, Newport avenue, and Irvine boulevard, has been awarded to Hart & Ducey, for $9229.20. Unit prices were as follows: 6300 cu. yd. excavation at 30c., 19,364 lin. ft. shaping roadbed at 5c., 18.3 cu. yd. class A concrete structures at $10, 3830 cu. yd. class B concrete in pavement at $1.60, and 1200 lb. reinforcing steel at 5c. Engineer's estimate was $9990.52. Other bidders were Moughmer & Rupp, $9618.98; Max L. Hubermann, $9690.90; Isbell Construction Co., $10,219.80; J. Driskill, $10,452.62; Oscar Ford, $10,701.76.

SANTA BARBARA—Contract for improving West boulevard has been awarded to Municipal Improvement Co., Richmond, for 18c. per sq. ft. for asphalt pavement, and 18c. per sq. ft. for concrete gutter.

SANTA CRUZ—Construction of pavement on King street, Ocean View avenue, Branciforte avenue, and Soquel avenue is being considered. Estimated cost is $75,000. It will probably be undertaken about October 1. W. J. Thompson is city engineer.——Contract for construction of pavement on Mission street has been awarded to C. Greenfield, for $25,831.73.——Citizens are considering construction of county highway system. E. J. Kelly is interested.

SANTA ROSA—Bids will be received until noon, September 16, for construction of reinforced concrete retaining wall near Glen Ellen, and for construction of two reinforced concrete bridges, one near Grippi and the other near Two Rock. Plans from W. W. Felt, county clerk, upon deposit of $5.

SOUTH SAN FRANCISCO—Board of trustees will receive bids until 8 p.m., September 7, for grading and paving Grand avenue extension. Work includes 6000 cu. yd. of grading, and 40,000 sq. ft. of 2-in. topeka wearing surface on 5-in. concrete base. George A. Kneese is city engineer.

STOCKTON—Towns of Ripon and Manteca have voted in favor of creating lighting districts.——Contract for improvement of east side of East street from North to Poplar has been awarded to Federal Construction Co., Sharon Bdg., San Francisco, for $9348.47. Engineer's estimate was $9640.75.——Election has been called for October 16 to vote on the formation of the West Side irrigation district.——Contract for paving several streets has been awarded to Eaton & Smith, 11th and Harrison streets, San Francisco, for $84,556.70. Engineer's estimate was $86,726.50.

SUNNYVALE—Dredging of channel to San Francisco bay is being considered. F. P. McCray is town engineer.

SUSANVILLE—Contract for construction of courthouse has been awarded to James L. McLaughlin, 244 Kearny street, San Francisco, for $77,977. All bids for construction of county hospital were rejected because too high.

TERRA BELLA—Terra Bella irrigation district has been organized at election. F. C. Rickey is director and E. R. Clemens, asseyor and collector. Plan involves impounding water of Deer creek and the irrigation of about 10,000 acres of orange and olive land. Estimated cost of work is $650,000. S. E. Kieffer, 57 Post street, San Francisco, is engineer.

VENICE—Contract for construction of 29,000 sq. ft. of asphalt concrete pavement has been awarded to Braun, Bryant & Austin, Santa Monica, for 13.64c. per square foot.

VERNON—Contract for improving Alameda street has been awarded to Los Angeles Paving Co., H. W. Hellman Bdg., Los Angeles, for 19.5c. per sq. ft. for asphaltic concrete paving.

VISALIA—Board of supervisors will hear petition for formation of Strathmore-Lindsay irrigation district on September 10. District will contain 100,000 acres.——Contract for construction of concrete bridge on state highway over Kings river near Kingsburg, has been awarded to Turner Co., Los Angeles, for $14,333.——Board of supervisors will receive bids until September 8 for construction of eight miles of mountain road. Estimated cost is $15,000.

YREKA—Board of supervisors has decided to commence to grade and pave road to Fort Jones and Scott Valley, about 6 miles, next spring. Estimated cost is $60,000.

YUBA CITY—Contract for construction of Barry schoolhouse has been awarded to Gould Bros., for $2700.

OREGON

EUGENE—Winino Hot Mineral Springs Co. will spend $100,000 on improvements at hot springs 35 miles from here. Herbert Bros. have been awarded contract for erection of sawmill.

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FLAVEL—Contract for construction of extension to dock of Seattle, Portland & Spokane R. R. has been awarded to J. A. McEachern Co., Colman Bdg., Seattle.

GRANTS PASS—Contract for 3 miles of grading, about 60,000 cu yd. in all on California & Oregon Railroad has been awarded to A. Anderson.

GRESHAM—City council is considering paving principal streets. R. R. Carlson is interested.

HALFWAY—Bonds for $20,000 for construction of water system have been voted.

MEDFORD—Sugar refinery costing $600,000 will be constructed. W. H. Gore and F. S. Bramwell, of Western Sugar Co., Salt Lake City, Utah, are interested.——Contract for construction of Pacific highway from Tolo to Josephine county line has been awarded to Chris Natwick, Eagle Point, for $16,659.90.

PORTLAND—Contract for construction of sections A, B, G, H, and I of St. Helens road has been awarded to Oscar Huber, Electric Bdg. Bitulithic pavement on concrete base will be used. Contract for construction of sections C, D, E, and F has been awarded to Jeffery & Bufton, Failing Bdg. Wooden blocks on concrete base will be used. Contract for construction of sections J and K has been awarded to Montague-O'Reilly Co., Blake-McFall Bdg. Concrete pavement will be used. Contract for construction of section L has been awarded to Jeffery & Bufton. Brick pavement on concrete base will be used. Contract for construction of section M has been awarded to Oscar Huber. Bitulithic pavement on crushed rock base will be used. Total cost of 4 miles of road will be about $76,000——Contract for construction of 30-mile extension of Oregon-Washington Railroad & Navigation Co. line from Riverside to Crane Creek has been awarded to Twohy Bros., 219 E. 60th street.——Southern Pacific Co. will start to electrify line to Corvallis as soon as the city council grants franchise.

ROSEBURG—Oregon Supreme Court has rendered decision upholding right of city to issue bonds for construction of railroad in conjunction with Kendall Bros. of Pittsburg. This removes last obstacle to construction of road.——State highway department has prepared plans for bridges in Douglas county, and county commissioners will soon ask for bids. R. W. Marsters is county judge.

SALEM—State bond issue of $10,000,000 for road construction has been proposed. E. I. Cantine is state highway engineer.

SIUSLAW—Contract for repair of wharves and tramways and extending jetties at mouth of Siuslaw river, has been awarded to Miami Quarry Co., Portland, for $176,570.

WEST LINN—Contract for construction of water system has been awarded to Oregon Engineering & Construction Co., Oregon City, for $57,928.

WASHINGTON

ABERDEEN—Bridge over Chehalis river will be rebuilt. Bridge will be 240 ft. long and the estimated cost is $15,000. Charles Evan Fowler, Central Bdg., Seattle, is preparing plans.

BELLINGHAM—Contract for construction of 22,400 sq. yd. sheet-asphalt pavement on Lake road has been awarded to L. H. Lich, for $41,236.50.——Contract for construction of 3200 sq. yd. sheet asphalt and 4400 sq. yd. two-course concrete pavement on Harris avenue has been awarded to K. Sauset, for $11,148.——Bids for construction of 7700 sq. yd. of pavement on Elk street have been opened. Independent Asphalt Paving Co., Northern Bank Bdg., Seattle, was low bidder for asphalt pavement at $11,287, and Peterson, Webel & Hawkins were low bidders for concrete pavement at $12,637.

CATHLAMET—Bids will be received until 1 p.m., September 7, by B. Heron, county auditor, for clearing five miles of state road No. 19, from Kelso to Ilwaco.

CHEHALIS—Contract for graveling one mile of road on Jackson prairie has been awarded to Speaker & McKee, for $5928.39.

Engineering Societies and Conventions

IDAHO SOCIETY OF ENGINEERS. Ira F. Schaffner, secretary, Boise.

Los Angeles Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Ford W. Harris, secretary, 1029 Higgins building.

Los Angeles Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Edward Woodbury, secretary, 255 East 3rd street.

OREGON SOCIETY OF ENGINEERS. Orrin E. Stanley, secretary, room 409, City Hall, Portland.

Portland Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. Charles McGonigle, president, care Western Sheet Metal Works.

Portland Section, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Paul Lebenbaum, secretary, 45 Union Depot.

San Francisco Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. E. T. Thurston, Jr., secretary, Mechanics Institute building.

San Francisco Section of AMERICAN SOCIETY OF MECHANICAL ENGINEERS. F. W. Gay, secretary, care J. G. White & Co., Alaska Commercial building.

San Francisco Section of AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. A. G. Jones, secretary, 811 Rialto building.

Southern California Association of Members of AMERICAN SOCIETY OF CIVIL ENGINEERS. W. K. Barnard, secretary, 701 Central building, Los Angeles.

Coming Conventions

AMERICAN BUILDERS' WEEK, San Francisco, October 18-23. E. T. Thurston, secretary, 57 Post street, San Francisco.

AMERICAN ELECTROCHEMICAL SOCIETY, San Francisco, September 16-18. J. W. Richards, secretary, South Bethlehem, Pennsylvania.

AMERICAN PETROLEUM SOCIETY, San Francisco, October 25-30. Irving C. Allen, secretary, 506 Custom House, San Francisco.

AMERICAN INSTITUTE OF MINING ENGINEERS, San Francisco, September 16-18. Bradley Stoughton, secretary, 29 West 39th street, New York.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, San Francisco, September 16-18. F. L. Hutchinson, secretary, 33 West 29th street, New York.

AMERICAN MINING CONGRESS, San Francisco, September 20-25. J. F. Callbreath, secretary, Washington, D. C.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, San Francisco, September 16-17. Calvin W. Rice, secretary, 29 West 39th street, New York.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, San Francisco, September 16-18. J. J. Blackmore, secretary, 29 West 39th street, New York.

AMERICAN SOCIETY OF CIVIL ENGINEERS, San Francisco, September 16-19. Charles Warren Hunt, secretary, 220 West 57th street, New York.

AMERICAN GAS INSTITUTE. San Francisco, September 27 to October 1. George G. Ramsdell, secretary, 29 West 39th street, New York.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. San Francisco, October 4-9. E. B. Burritt, secretary, 165 Broadway, New York.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS. San Francisco, September 21-22. F. M. White, secretary, Madison, Wisconsin.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. San Francisco, September 23-24. W. H. Ross, secretary, 154 Nassau street, New York.

CALIFORNIA CONFERENCE ON CITY PLANNING. Oakland, September 7-11, Charles H. Cheney, secretary, Crocker Bdg., San Francisco.

INTERNATIONAL GAS CONGRESS. San Francisco, September 27 to October 1. George G. Ramsdell, secretary, 29 West 39th street, New York.

INTERNATIONAL ENGINEERING CONGRESS, San Francisco, September 20-25. W. A. Cattell, secretary, Foxcroft building, San Francisco.

INTERNATIONAL IRRIGATION CONGRESS, Stockton, September 13-14; Fresno, September 15-16; Sacramento, September 17-18; San Francisco, September 20. Arthur Hooker, secretary, Sacramento, during July; Stockton, during August and September.

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LEAGUE OF CALIFORNIA MUNICIPALITIES, Oakland, September 7-11. H. A. Mason and W. J. Locke, secretaries, Pacific building, San Francisco.

PACIFIC HIGHWAY ASSOCIATION OF NORTH AMERICA, San Francisco, September 16. H. L. Bowlby, executive officer, 510 Chamber of Commerce building, Portland, Oregon.

PAN-AMERICAN ROAD CONGRESS, Oakland and San Francisco, September 13-18. Charles P. Light, secretary, Colorado building, Washington, D. C.

TRI-STATE GOOD ROADS ASSOCIATION. San Francisco, September 13-14. George E. Boos, secretary, Medford, Oregon.

Personal

W. S. FARLEY has been appointed chief engineer for the Fresno County highway commission.

F. J. BOLAND, formerly city engineer of Coalinga, has been appointed city manager of San Rafael, California.

ALBERT DE RUIZ, formerly assistant city engineer of Long Beach, has been appointed city engineer, succeeding B. F. Dupuy.

H. A. KLUEGEL, of Oroville, California, has gone to Denver, where he will act as consulting engineer for the city in water-supply investigations.

WALTER H. OLIVER has been appointed division engineer for the Atchison, Topeka & Santa Fe railroad, with headquarters at San Bernardino, California.

WALTER W. WEIR, drainage engineer for the United States Department of Agriculture, is investigating drainage conditions in the South San Joaquin irrigation district.

GEORGE M. RICE has been appointed chief engineer for the Puget Sound & Willapa Harbor railroad, succeeding C. H. Byers. His headquarters will be at Raymond, Washington.

E. G. HOBSON, for several years supervising engineer for the United States Reclamation Service with headquarters at Portland, has opened offices as a hydraulic engineer at 202 Central Bdg., Portland, Oregon.

F. A. KETTREDGE, for some time past connected with the Oregon state highway department as division engineer on the Siskiyou mountain work in Jackson county, has resigned to take a position with the California state highway commission.

A commission of engineers from the United States Rivers & Harbor Board, composed of W. M. BLACK, L. H. BEACH, H. C. NEWCOMER, E. N. JOHNSTON, F. V. ABBOTT, E. E. WINSLOW, and H. W. WEBBER is in Los Angeles, investigating harbor and flood conditions.

CLARENCE S. JARVIS has been appointed chief engineer for the Sevier River Land & Water Company, with headquarters at 311 McConnick Bdg., Salt Lake City, Utah. The project is situated in Millard county and embraces about 60,000 acres, 10,000 being now supplied with water.

SIMON BENSON, capitalist and good-roads enthusiast of Portland, was selected by a commission appointed by the Governor as the first citizen of Oregon, and, as such, received a medal from the Panama-Pacific Exposition on August 17. This was the first of such medals to be bestowed, the intention being to present a medal to the first citizen of each state.

The Sacramento Good Roads Association has been formed in Sacramento, California, to further the construction of a system of county highways. The following officers were elected: president, G. W. PELTIER; vice-presidents, C. B. BILLS, EMMETT PHILLIPS, R. T. DEVLIN, BENJAMIN LEONARD, L. C. SIMPSON; secretary, W. A. MEYER; assistant secretary, JOHN MONTGOMERY.

KENNETH A. HERON, formerly engineer for the Modesto irrigation district, has been appointed chief engineer for the Goose Lake Valley Irrigation Company, with headquarters at Lakeview, Oregon. The company has recently completed a 60,000 acre-foot reservoir and it is expected that 25,000 acres will be under ditch by next spring, and that additional acreage will be irrigated in the future.

R. P. MCLAUGHLIN has been appointed state oil and gas supervisor for California. Mr. McLaughlin was geologist for the Associated Oil Company for some time and for the past two or three years has been in charge of the petroleum department of the California State Mining Bureau. He has appointed as deputies, M. J. Kirwan, E. B. Latham, R. B. Moran, and Chester Naramore. Mr. Kirwan has been oil-well commissioner for Fresno county for several years and will continue to be stationed at Coalinga. Mr. Latham has filled a similar position in the Midway field and will have his headquarters at Santa Maria. Mr. Moran will be stationed in Los Angeles and Mr. Naramore's activities will be in both Kern and Ventura counties. Both of the latter are experienced in oil-production. The deputies' districts have not been defintely arranged, the idea being to use a man wherever he happens to be most needed, without regard to district boundaries.

Obituary

J. E. GRAY, president of the Gray Oil Company, and a pioneer operator in the Kern County oilfields, died August 15, at St. Helena, California.

WILLIAM S. PORTER, formerly vice-president and general manager of the Associated Oil Company, died at Mount Zion hospital, San Francisco, after an illness of two months.

Commercial Paragraphs

The corporate name of the MARION-OSGOOD CO. has been changed to The Osgood Co. For some time past, the company has been using the trade name 'Osgood' on its steam-shovels and other machinery.

The business of the PACIFIC TANK & PIPE CO. in the Northwest has increased to such an extent that the National Tank & Pipe Company of Portland, Oregon, has been organized to take over that portion of the company's affairs. The same persons will be interested and have charge of the management of both companies. The plant of the National Tank & Pipe Company is at Kenton station, within the city limits of Portland, occupies twelve acres, and has facilities for both land and water transportation.

Catalogues Received

THE STORY OF PARANITE. The Manhattan Rubber Manufacturing Co., Pittsburgh, Pa. P. 24. Illustrated. Describes the use of paranite gaskets on oil and gas lines.

CONTRACTORS CARS. Catalogue No. 64, The Kilbourne & Jacobs Manufacturing Co., Columbus, Ohio. P. 36. Illustrated. Describes the different dump cars manufactured by the company.

HOPPES V-NOTCH METER. Hoppes Manufacturing Co., Springfield, Ohio. P. 16. Illustrated. Describes the construction and use of this meter, which is particularly valuable for measuring boiler-feed water.

LEA-COURTENAY CENTRIFUGAL PUMPS. Lea-Courtenay Co., Newark, N. J. P. 64. Illustrated. Describes the pumps manufactured by the company and gives a number of useful tables for use in designing pumping plants.

RICHMOND CEILING INSERTS AND RICHMOND SCREW ANCHORS. The Richmond Screw Anchor Co., Pulitzer Bdg., New York. These two four-page illustrated pamphlets describe some of the articles manufactured by the company.

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